Nanoscience

Faculty of Mathematics and Natural Sciences,
University of Groningen

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Project number: Q0393

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This report was finalized on 12 December 2012

Report on the master's programme Nanoscience of the University of Groningen

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point.

Administrative data regarding the programme

Master's programme Nanoscience

Name of the programme:	Nanoscience
CROHO number:	60618
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	none
Location(s):	Groningen
Mode(s) of study:	full time
Expiration of accreditation:	31 December 2013

The visit of the assessment committee Nanoscience to the Faculty of Mathematics and Natural Sciences of the University of Groningen took place on 18, 19 and 20 September 2012.

Administrative data regarding the institution

Name of the institution:	University of Groningen
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	applied (pending)

Quantitative data regarding the programme

The required quantitative data regarding the programme are included in Appendix 5.

Composition of the assessment committee

The committee that assessed the master's programme Nanoscience consisted of:

- Prof. dr. F.C. De Schryver, professor emeritus at the Faculty of Sciences, Department of Chemistry, Catholic University of Louvain.
- Prof. dr. J. Hellemans, emeritus professor at the Faculty Sciences, Department of Physics and Astronomy, Catholic University of Louvain.
- Prof. dr. J.J. McGarvey, emeritus professor of Chemistry and visiting research professor at the School of Chemistry and Chemical Engineering, Queen's University of Belfast.

- Prof. dr. A.D. Wieck, professor of Applied Solid State Physics at the Ruhr University at Bochum.
- Prof. dr. A. Revcolevschi, emeritus professor of Solid State Chemistry at the University of Paris 11 (Orsay).
- P.M. Muilwijk, master student of Nanotechnology at the University of Twente.

The committee was supported by Mrs. M. (Muriel) Jansen, who acted as secretary. Sietze Looijenga, acting director of QANU, acted as project co-ordinator.

Appendix 1 contains the curricula vitae of the members of the committee.

Working method of the assessment committee

Preparation
After receiving the critical reflection from the programme, the project manager of QANU checked it for quality and completeness of information. After it was found to be in order, it was forwarded to the members of the committee. They read the critical reflection in preparation for the site visit. They also read a total of fifteen master's theses.

On 18 September 2012 the committee held its formal kick-off meeting. During this meeting, the committee was instructed about its task and the assessment procedure.

Site visit
The site visit took place on 19 and 20 September. An overview of the programme of the site visit is included in Appendix 6 of this report. During the preparatory meeting on 19 September, the committee formulated several questions based on the information already received.

At the request of the committee, the programme selected representatives for the interview panels. Prior to the visit, the committee received an overview of the programme and its representatives for approval. During the site visit the committee spoke with representative members of the Faculty Board, the management of the programme, current students, co-ordinating teachers of the core modules, the Course Committee and the Board of Examiners and received e-mail statements from alumni.

The committee interviewed students from the second year of the programme. This was due to the fact that when the site visit took place, the freshman students had just started their programme. A very important part of the programme is the self-study during the first five weeks of the first year, and the programme management decided not to interrupt this important process of the freshman students. The committee understands and accepted this decision. Instead, the committee talked intensively about the first year of the programme with the students from the second year.

Prior to the site visit, the committee requested the programme to prepare study materials, such as core modules, exams and books. It inspected these materials during the site visit. An overview of these materials is included in Appendix 7 of this report.

The committee also gave students and staff members the opportunity of an open consultation hour during the site visit. No one made use of this.

After the concluding interview with the management, the committee held an internal meeting to discuss its findings, phrased its conclusions and gave its assessment of the themes and standards. At the end of the site visit, the chairman of the committee presented an oral report of the preliminary findings of the committee, including a number of general observations and some first impressions of the programme.

Report
The secretary produced a first draft of the report, based on the committee's findings. After the committee approved it, the report was submitted to the faculty. The faculty checked the report for factual accuracy. The faculty's comments were discussed with the committee. Then the report was finalized.

Decision rules
In accordance with the NVAO's Assessment Framework for Limited Programme Assessments (as of 6 December 2010), the committee used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

This report describes the findings and assessment of the committee in evaluating the master's programme in Nanoscience. The assessment is based on the critical reflection, additional information provided during the site visit, the interviews conducted during the site visit and a selection of master's theses.

The committee is highly impressed by this unique programme. In contrast to regular master's programmes, it established that the ambition of this programme is definitely much higher. It is of the opinion that the programme is a very unique one with a strong focus on research training. Students, carefully preselected after a personal interview, are given the opportunity to participate in the Zernike Institute, a prominent and outstanding research institution. The participating staff and facilities are excellent. The size of the selected cohort of students is limited on purpose so they can receive a highly personalized tutoring. This small size of the group creates a strong team spirit and, together with the high commitment of students, is a primary reason for the high success rate.

The relatively high assessment scores awarded by the committee are explained by these unique circumstances, and that is why the committee wants to exemplify this programme as a 'best practice' for other master's programmes in Nanoscience (national and international).

Standard 1: Intended learning outcomes
The programme has been set up by the Faculty of Mathematics and Natural Sciences of the University of Groningen together with the Zernike Institute. The Zernike Institute for Advanced Materials at the University of Groningen is an interdisciplinary research institute, which received the coveted status of national top research institute in 1999. This distinction has been reconfirmed several times since and was even deemed 'exemplary' in the last evaluation. In the 2011 *Times Higher Education* ranking of research institutes in materials science worldwide, the Zernike Institute was ranked fourth. The aim of the Zernike Institute is to benefit from its research strength, as well as to guarantee a steady influx of qualified PhD candidates.

The Faculty of Mathematics and Natural Sciences of the University of Groningen aims for a leading position in education and research by offering top programmes linked to top research groups in the faculty, like the Zernike Institute. For these programmes the brightest and most ambitious students from all over the world are being selected. Therefore, the Faculty of Mathematics and Natural Sciences of the University of Groningen decided to specifically call this programme a Top Master Programme in Nanoscience. It is a highly selective master's degree programme, which imposes additional criteria for admittance.

The programme is mainly based on the definition of Nanoscience from the Royal Society and the Royal Academy of Engineering, which both consist of the world's most eminent scientists, and therefore that definition is highly regarded. Together they defined the field of Nanoscience in their report *Nanoscience and Nanotechnologies: opportunities and uncertainties*. The committee confirms that this frame of reference, in combination with specific elements that are defined by the programme itself, gives a very good reflection of the domain of Nanoscience and is a perfectly acceptable foundation for this particular programme.

The qualifications formulated by the programme define knowledge, skills and attitude at the level that meets the requirements for starting a PhD project. Since the programme is aimed at a career path in research, the intended qualifications match very well with the demands of the

international scientific community in the newly emerging field of Nanoscience. All teaching staff members are well qualified as researchers, and the research institute is a centre of excellence, as mentioned above and also according to the committee. All students participate in this research environment. It is the confrontation with this research practice that challenges students to achieve the intended qualifications. The committee is highly impressed by this and is convinced that this is a very unique selling point of the programme.

Standard 2: Teaching-learning environment
The combination of all the unique aspects of the programme, especially the actual combined *application* of all these aspects, creates an outstanding and highly challenging and motivating teaching and learning environment for students. The committee is convinced that this adds great value to the programme.

The personnel and facilities are excellent, the cohorts of students are very small, the entrance is highly selective, and the curriculum is outstanding. This master's programme in Nanoscience is a very high-level degree course with a strong emphasis on research training and a very demanding curriculum for a select group of students that is able to handle this challenge. That is why there is an extremely demanding intake based on excellent selection criteria. This selection is necessary because the programme has such a challenging curriculum.

Students are given the unique opportunity to participate in an outstanding research institute. They carry out part of their master's thesis projects in nationally and internationally leading research groups. In this way, the educational programme provides a challenging and motivating environment in which a select group of students is offered an excellent and unique opportunity for education in Nanoscience. The committee is convinced that, since the programme aims at a career path in research, the intended qualifications are strongly focused on the academic skills demanded by the international scientific community in Nanoscience. Therefore, it is convinced that the requirements for university degree courses are absolutely fulfilled and comparable with the best educational institutes on an international level.

The committee is of the opinion that there is an excellent relationship between the intended learning outcomes and the content of the program. It is highly impressed by the excellent coherence of the curriculum, which is very well constructed and consists of highly relevant content. Knowledge, skills and awareness of the social context needed for a research career in nanoscience are very well presented in the curriculum. The curriculum guarantees its students an in-depth research experience with a solid academic basis.

Teachers and supervisors associated with the programme represent the excellent research groups taking part in the Zernike Institute. They form excellent role models for the students. The high-quality staff have expertise in all the necessary areas and excellent research and teaching abilities.

Standard 3: Assessment and achieved learning outcomes
The committee established that the assessment system of the programme functions very well. The examination structure has clearly been tailored to the intended learning outcomes of the programme. The committee has verified that there is a very large variety of assessment methods and that the tests and assessments are valid, reliable and transparent. It is convinced that this assessment system contributes greatly to making this programme special. It certainly contributes to the high level achieved by the students.

The committee is really impressed by the very high quality of the master's theses it studied; it

obtained a general impression of high standards for graduation. It concurred with most of the grades awarded to the theses by the supervisors, ranging from good to excellent. It is therefore convinced that the learning outcomes are being achieved at a high level. The graduates seem to have a broad range of possibilities to continue their research activities at an impressive level, judging by the examples seen by the committee.

The committee assesses the standards from the Assessment framework for limited programme assessments in the following way:

Standard 1: Intended learning outcomes	excellent
Standard 2: Teaching-learning environment	excellent
Standard 3: Assessment and achieved learning outcomes	excellent
General conclusion	excellent

The chair and the secretary of the committee hereby declare that all members of the committee have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 12 December 2012

Frans De Schryver

Muriel Jansen

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

In this standard the committee's findings are first examined against the internationally applicable domain-specific framework and the profile of the programme (1.1.1). Then attention is paid to the final qualifications and the level of their formulation (1.1.2).

1.1.1. Domain-specific framework and profile of the programme

Profile of the programme

According to the critical reflection, the Faculty of Mathematics and Natural Sciences of the University of Groningen together with the Zernike Institute, decided to set up a two-year, international, selective master in the field of Nanoscience.

The aim of the Zernike Institute is to benefit from its research strength, as well as to guarantee that the research institute receives a steady inflow of qualified PhD candidates. The Zernike Institute for Advanced Materials at the University of Groningen has been an interdisciplinary research institute since 1970. In 1999, it received the coveted status of national top research institute, a distinction that has been reconfirmed several times since. In the last evaluation for this distinction, the research institute was deemed 'exemplary'. In the 2011 *Times Higher Education* ranking of research institutes in materials science worldwide, the Zernike Institute was ranked fourth.

The Faculty of Mathematics and Natural Sciences of the University of Groningen aims for a leading position in education and research by offering top programmes linked to top research groups in the faculty, like the Zernike Institute. For these programmes the brightest and most ambitious students from all over the world are being selected. Therefore, the Faculty of Mathematics and Natural Sciences of the University of Groningen decided to specifically call this programme a Top Master Programme, because it is highly selective and imposes additional criteria for admittance.

Based on the information obtained during the site visit and in the critical reflection, the committee established that the master's programme in Nanoscience has a distinctive and unique profile as 'A *programme that prepares selected, exceptionally gifted students for a career in fundamental research in the new emerging field of Nanoscience in world-class institutes, through teaching and hands-on training by leading scientists'*. A unique element is that the entrance to this master's programme is highly selective. During the site visit the management added specifically that the main focus is to educate students in curiosity-driven research.

Management, students and alumni confirmed during the site visit that the master's programme is designed and delivered by active, world-class researchers in Nanoscience. They

convey to the students the knowledge, skills, attitude and ethics needed for an independent research career.

Students who have obtained their master's degree continue their education in a PhD programme, either at the Zernike Institute or elsewhere. The management, teaching staff, students and alumni demonstrated during the site visit the manner in which the master's programme in Nanoscience is tightly integrated with the research groups of the Zernike Institute.

Benchmarking
According to the critical reflection, the programme specifically prepares students for a career in fundamental research rather than for a career in application-oriented Nanotechnology. There is, therefore, a natural distinction between the fundamental-research-oriented programme offered by the Zernike Institute and the more application-oriented programme offered by MESA+ at the University of Twente. The committee has verified this and states that there are no national or international programmes identical to this master's programme in Groningen. Most such programmes have a much narrower focus and are mainly concerned with applied technology. Therefore, the committee is of the impression that this is a unique and a 'one of a kind' programme compared to other, similar programmes.

Domain-specific framework
The management of the programme indicated during the site visit that Nanoscience is a highly interdisciplinary field, uniting parts of chemistry, physics, and molecular biology. The field is also highly international. As it is still quite young, and not many universities offer an interdisciplinary programme like the Zernike Institute does, no universally agreed standard set of competences has been defined yet. As a leader in the field and through its collaborations with other leading centres in Nanoscience, the Zernike Institute aims to help define a standard set of competences and will adapt its curriculum accordingly if the need to do so becomes evident.

In preparation for the definition of such a standard set, the management stated during the site visit that the current master's programme is based upon the definition of Nanoscience from the Royal Society and the Royal Academy of Engineering.

The Royal Society and the Royal Academy of Engineering include many of the world's most eminent scientists and are highly regarded. Together they defined the field of Nanoscience in their report *Nanoscience and Nanotechnologies: opportunities and uncertainties*. In June 2003 the UK Government commissioned the Royal Society and the Royal Academy of Engineering to carry out an independent study into current and future developments in Nanoscience and Nanotechnologies and their impacts. One of the remits of the study was to define what is meant by Nanoscience and Nanotechnologies.

The committee considers that this frame of reference, in combination with the specific elements that are defined by the programme itself, clearly reflects the domain of Nanoscience. It believes that this domain-specific reference framework is a perfectly acceptable foundation for the present master's programme.

1.1.2. Learning outcomes and level
The intended learning outcomes of the master's programme in Nanoscience are described in Appendix 3.

The management of the programme indicated during the site visit that Nanoscience is a highly interdisciplinary field, uniting parts of chemistry, physics, and molecular biology. The committee studied the final qualifications of the master's programme in Nanoscience and finds them very relevant to the domain of the programme. All the learning outcomes are recognized and put into the perspective of the requirements needed to start a PhD project. Therefore, the committee believes that the final qualifications are of an excellent standard.

The committee is convinced that the final qualifications of this programme exceed the demands for an academic master's programme. It established that the intended learning outcomes are in complete accordance with the Dublin descriptors for master's degrees. It is also convinced that the relationship with the Dublin descriptors is very well described and that there is an excellent relationship with academic aspects.

Considerations
The committee is impressed by the unique profile of this master's programme and is convinced that, in contrast to regular master's programmes, the ambition and intentions of this particular programme are definitely higher. In regular master's programmes there is less emphasis on research training.

The qualifications formulated by the programme define knowledge, skills and attitude at the level that meets the requirements for starting a PhD project. Since the programme is aimed at a career path in research, the intended qualifications match very well with the demands of the international scientific community in Nanoscience. All members of the teaching staff are well qualified as researchers, and the research institute is recognized as a centre of excellence. All students participate in this research environment. It is the confrontation with the research practice itself that is challenging students to achieve the intended qualifications. The committee is highly impressed by this and is convinced that it forms a unique selling point of the programme.

The programme is mainly based on the definition of Nanoscience from the Royal Society and the Royal Academy of Engineering, as presented in their report *Nanoscience and Nanotechnologies: opportunities and uncertainties*. The committee confirms that this frame of reference, in combination with specific elements defined by the programme itself, gives a very good reflection of the scientific domain of Nanoscience. It states that this domain-specific reference is a perfectly acceptable foundation for the current master's programme. Furthermore, it is convinced that the intended learning outcomes perfectly match this domain-specific reference framework of the newly emerging field of Nanoscience.

Conclusion
Master's programme Nanoscience: the committee assesses Standard 1 as **excellent**.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings
In this standard the design and the coherence of the curriculum were examined (2.1.1). Next, the committee looked at the extent to which the final qualifications are translated within the curriculum (2.1.2) and the amount of attention paid to the acquisition of research skills (2.1.3) and the professional practice (2.1.4). Finally, the following topics were considered: the teaching concept (2.1.5) and the facilities (2.1.6), intake, study load and outcomes (2.1.7), teaching staff (2.1.8) and programme-oriented internal quality assurance (2.1.9).

2.1.1. Curriculum
The committee established during the site visit and according to the information in the critical reflection that the curriculum is structured very well and consists of an excellently designed curriculum. It is highly impressed by the coherence of the curriculum, which consists of very relevant content. Students and alumni confirm this and stated during the site visit how much they valued the opportunity to participate in this unique programme.

Immediately at the start of the curriculum (weeks 1 - 5), each student spends five weeks on an individually assigned 'guided self-study'. This activity is 'guided' in the sense that for each of the possible areas of deficiencies, a tutor is available for guidance and help. This self-study is meant to ensure that all students in the programme possess sufficient background knowledge to follow the core module courses successfully.

The committee reviewed the list of the literature for self-study and considers that the requirements are of a very high standard, very relevant for the field of Nanoscience and also very demanding. The teachers, students and alumni confirm this, but state that these demands are feasible, thanks to the tough selection procedure. For that reason students are advised and encouraged to start the self-study in the period preceding their actual arrival in Groningen. Teachers indicate that as incoming students have quite disparate backgrounds, this homologation phase is needed to provide them with a common starting level.

The first half of the first year of the curriculum (weeks 6 - 23) consists mainly of the tightly integrated core modules. There are three core modules: *Preparation of nanomaterials and devices, Characterization of nanomaterials* and *Fundamental and functional properties of nanomaterials*. They define the character of the curriculum and form a very intense phase of study, mainly in the form of lectures and some practical exercises. The students acquire a profound and unified overview of the relevant aspects of physics, chemistry and molecular biology (the core knowledge of Nanoscience). Taught by a number of faculty members, the core modules expose the students to the full breadth of the field of Nanoscience.

The contents of these core modules are primarily the responsibility of three co-ordinating teachers and are continuously improved and updated. The committee examined their contents and is convinced that the entire chain of preparation, characterization and functional properties of materials (so characteristic of the Zernike Institute) is presented very well in these core modules.

The final half of the first year is devoted to electives, chosen by the student in consultation with the mentor and/or the supervisor of the group where s/he plans to carry out the master's thesis project (weeks 24 - 42). In this period, the student also writes a paper and carries out a small research project resulting in an oral presentation at a scientific symposium to which Zernike Institute scientists and students are invited. The organization of the symposium, including logistics and invitations, is managed by the students. The small research project and the master's thesis project cannot be carried out in the same research group. In

that way the student is stimulated to learn the knowledge/expertise of another discipline.

The individual interest of the student and the requirements needed for the limited research project define which electives a student will choose. The electives can be selected from all master-level courses in the regular physics and chemistry curricula offered by the Faculty of Mathematics and Natural Sciences. The choice of electives requires consultation with the mentor and approval by the Board of Examiners.

The second year concentrates on the remaining electives, the thesis project and writing a PhD research proposal.

The management intends to include more bio-related aspects in the curriculum and really wants to attract a new staff person with the appropriate background who could provide the adequate expertise to cover these aspects. Pending the arrival of such an expert, the management has already incorporated several bio-related aspects in the curriculum. Students can now choose an elective course in molecular biology, and some of them are involved in high-level, bio-related, small research projects.

The committee highly appreciates this decision of the management to implement bio-related aspects in the curriculum already and encourages the programme to continue its efforts. Furthermore, the committee recommends making molecular biology a permanent part of the core modules instead of just an elective and to put biophysics as an elective course in the curriculum.

2.1.2. Relation between learning objectives and course content

The committee looked at the correspondence between educational objectives and courses. According to the committee, there is a very good relationship between the intended learning outcomes and the content of the programme. It notes that the curriculum is organized in such a way that students can achieve all the learning outcomes.

The committee has verified that the achievement of the educational objectives of the master's programme in Nanoscience is ensured by the various components of the curriculum. Because the programme aims for an integrated approach, there is no one-to-one correspondence between educational objectives and individual courses.

The management of the programme indicates that Nanoscience is a highly interdisciplinary field, uniting parts of chemistry, physics, and molecular biology. Management, teaching staff, students and alumni pointed out during the site visit that this interdisciplinarity is clearly reflected in the curriculum.

During the site visit it became clear that the students and alumni are very pleased with the way the curriculum is constructed. Students and alumni think that because they are so strongly connected to the Zernike Institute research groups, they learn much more than in regular master's programmes. Some pointed out that they did not fully appreciate at the outset why they had to learn about a certain topic. But in the end, especially during the small research project, everything became clear. Students and alumni consider that the content of the core modules and the electives has been selected very carefully.

The coordinating teachers of the core modules were not surprised that the students indicated that they learn what they need. That is the primary focus of this master's programme: 'We create individual programmes that combine all topics that are available in the Zernike

Institute'. The committee is very much impressed by this and thinks that the teaching staff pays a lot of attention to the content of the curriculum and the way the individual programmes are designed/constructed.

2.1.3. Academic orientation

The committee noted that, according to the critical reflection and interviews conducted during the site visit, the qualifications formulated by the programme define knowledge, skills and attitude at the level that meets the requirements for starting a PhD project. It established that the programme aims at a very demanding career path in research. It is therefore convinced that the intended qualifications are strongly focused on the academic skills demanded by the international scientific community in Nanoscience.

The committee therefore thinks that the requirements for university-degree courses are absolutely fulfilled and exceed the requirements of the best educational institutes on an international level.

Furthermore, all members of teaching staff are well qualified as researchers, and the research institute is recognized as a centre of excellence. All students participate in this research environment. It is the confrontation with research practice itself that challenges students to acquire excellent scientific and research skills.

2.1.4. Attention paid to the professional practice

The committee noted during the site visit and according to the information in the critical reflection that most of the students continue their education in a PhD programme at the Zernike Institute or another prominent research institute. The current students interviewed by the committee during the site visit indicate that they will write their research proposals for funding in mid-spring 2013. This step forms a very important part of the curriculum.

Alumni indicated that if a student wants to do a PhD elsewhere, s/he is fully assisted by researchers from the Zernike Institute research groups. They help in providing relevant contacts and opportunities. Students feel that they are very well informed by their teachers about opportunities upon completion of this master's programme. They stated that their teachers have many valuable and important contacts and that they are made aware of what takes place in other national or international research groups and in the rest of the field of Nanoscience.

2.1.5. Didactic concept

The committee examined the didactic vision underlying the teaching in the programme.

It established that the teaching concept aims for an approach that facilitates students learning to become outstanding researchers by doing actual research alongside world-class role models. Therefore, students are first taught the fundamental knowledge they need to successfully finish this master's programme.

The first year of the programme is mainly used to provide the students with the knowledge, skills, and attitude they need for independent research. Knowledge is mainly conveyed through lectures and reading assignments. The lectures take the form of discussion groups. Experimentation skills are trained through laboratory exercises, communication skills through the paper assignment and the oral presentation. Interactions between the students themselves are actively encouraged (and enforced in the case of the symposium where the small research projects are presented). The availability of a common study room helps in this regard.

The second year is devoted to a large research project, in close interaction with active researchers. Reporting and discussing results (and any problems encountered) are integral parts of this work. Finally, writing a PhD-level project proposal forces the student to assess what is new and what is still unknown but 'doable' in a field.

During the site visit students and alumni indicated by e-mail that they learn a lot during the programme especially because of the small group size, the intense interaction between students and the research groups, and the amount of actual lab work/experience. Students and alumni are very positive about the 'hands-on' setup of the programme and the active role they have in different research groups. The committee is very pleased with this and thinks the programme provides an excellent balance of methods.

2.1.6. Facilities and study support

Facilities

Based on the documentation received, the tour during the site visit and the interviews conducted with various groups, the committee ascertained that the facilities for students are excellent. The facilities contain several cleanrooms, a biology lab, project spaces, consultation rooms, et cetera.

The research equipment is in general much better than the equipment in other national or international universities with similar programmes or research groups. The committee is very impressed because students have access to these facilities and have permission to use this outstanding research equipment. Students also feel privileged to be able to use this modern research equipment, and both students and alumni considered this to be a highly motivating point.

If an item of equipment is broken, it is repaired by a member of the technical staff or replaced very quickly.

Study support

During the site visit it became clear that students receive excellent guidance from a mentor who is a senior member of the scientific staff of the Zernike Institute. The mentor and student meet regularly to discuss progress and to guide the student in making choices on electives and a suitable thesis project topic. Both mentors and teachers look frequently at each student's progress in the curriculum. Students indicate that they experience this as very reassuring, especially when it comes to monitoring the pace of study in the programme. Teachers clearly indicate deadlines by which material should be ready. During the second year, when the student is working on the master's thesis project, the role of the mentor is taken over by the thesis project supervisor.

Furthermore, the programme encourages various peer-to-peer activities. Following a suggestion made by the students, incoming students will be assigned a student 'buddy'. These second-year students help the first-year students with substantive problems regarding the content of the programme and with issues regarding time management (planning of the study).

Students and alumni indicated that they are very content with the study materials provided by the programme. The coordinating teachers of the core modules stated that not all courses are backed by a textbook. This has a very plausible reason: sometimes textbooks are not available

yet because Nanoscience is a newly emerging field. In that case the teachers provide students with content they produce themselves.

Teachers provide their students with clear study guides. These guides indicate which areas/segments of theory should be studied. The guides also mention the study load of a certain course. Students expressed great satisfaction with this information.

2.1.7. Intake, study load and completion rates

The quantitative data regarding the programme are listed in Appendix 5.

Intake

According to the critical reflection, the field of Nanoscience combines topics traditionally taught in physics and chemistry, but neither of these traditional curricula fully prepares a student for a career in Nanoscience. Furthermore, in order to be able to participate successfully in world-class research, the student will have to master these topics in great depth. The average student will not be able to combine these dual requirements of depth and breadth within the limits of a two-year curriculum. The programme thus offers a very challenging curriculum to a select group of students able to handle this. A careful and strict selection procedure has been established to make sure that only students who are up to this challenge are admitted.

The highly selective criteria for admission to the master's programme in Nanoscience include:
- a bachelor's degree in either physics or chemistry, or in another field deemed appropriate by the Admissions Board;
- excellent documented proficiency in English;
- appropriate attitude, motivation, ambition, and talent;
- recommendations by qualified referees.

In the selection procedure, an explicit selection criterion is whether the student already has sufficient background knowledge for the five-week 'guided' self-study. Accepted students are strongly advised and expected to start studying the material assigned to them for the 'guided self-study' prior to the start of the programme, to lessen their workload in the first five weeks.

The Admissions Board selects potentially suitable candidates and invites them for an interview in Groningen, possibly after a telephone interview. During this one-hour interview, the candidate is asked to give a ten-minute scientific presentation on a topic of his or her own choice. This will be followed by a discussion with the three members of the Admissions Board, who will determine the student's attitude and motivation for the programme. The Admissions Board strongly focuses on the question of whether or not a student is capable of completing the programme successfully, has enough talent and has the profile of a curiosity-driven researcher.

The committee established during the interview with the management that the programme aims for the top 10% of the students in physics and chemistry. Of the applications the programme receives, about 50% are invited for an interview, a total of approximately 30. Of those interviewed, on average 50% are admitted.

The committee noted during the site visit that the recruitment of candidates for the master's programme takes place through several channels. The contacts the researchers in the Zernike Institute have with their peers all over the world are very important. The University of Groningen participates in educational fairs, especially in Asia and Eastern Europe, to

publicise the many courses it offers. Conventional means like advertisements in science journals and posters at science meetings are also used.

The committee asked the students and alumni where they learned about the master's programme in Nanoscience. Students and alumni indicated that they found out about the programme via positive feedback from successful foreign students from their former university and through a web search.

The foreign students indicate that the course has a very positive image abroad. This is the main reason why students from abroad opted for this programme. The critical reflection states that a web search will reveal the full description of the curriculum and examples of theses and other products on the Zernike Institute website, which are strong motivators.

About half of the students are from the Netherlands, the other half is from abroad (for example Iran, Ukraine, Pakistan, China and Poland). The management of the programme refers to the relatively high study load and the strict selection procedure as an explanation for the fact that half of the students are from abroad. Not every Dutch student is motivated to participate in such a demanding and high-level programme. Another reason is that most Dutch students choose a master's programme at the same university after their bachelor's degree, and not many are willing to move to Groningen for a master's programme after their bachelor's degree.

Study load
Based on the information provided and the interviews conducted with students, teachers and alumni, the committee established that the study load of the programme is heavy, but feasible. During the site visit it became clear that especially the study load of the individually tailored curriculum during the guided self-study is also heavy, but that once again these demands are feasible, thanks to the tough selection procedure. For that reason students are advised and encouraged to start the self-study in the period preceding their actual arrival in Groningen.

The critical reflection states that during the evaluation of the modules, the students are asked about the actual study load, and whether it was in accordance with the planned study load as mentioned in the study guides. If the evaluation outcome is unfavorable, then the Course Committee can advise changing the module. So far, no complaints have been reported. Students and alumni confirm this.

Completion rate
The critical reflection indicates that the master's programme in Nanoscience started in September 2003. So far, 47 students have graduated from this programme, and 46 have gone on to a PhD programme. Two cohorts are currently in the programme, consisting of nine and fifteen students.

The committee verified that the number of students finishing the curriculum within the planned time has been exceptionally high, as is the number obtaining the epithet *cum laude*, for which very high criteria have been set. The requirement at the University of Groningen for obtaining a *cum laude* is that the EC-weighted average of all grades is at least 8 (on the 10-point scale used). The master's programme in Nanoscience has the additional requirement that the average score, excluding the MSc thesis project, is also at least 8.

During the site visit the management stated that they decided at the start of the programme to limit the annual influx of students to fifteen. The management is convinced that this

decision contributes significantly to the excellent completion rates. Because of the limited group size, a very intensive and personal way of teaching and guiding the participating students is made possible. Students are active members of research groups (especially in their second year) and learn by working alongside world-class scientists. Every cohort of students becomes a strongly coherent group, and assists and learns from each other. This is a major contribution to the success of the programme. The students in each cohort form a tightly knit group, that help and stimulate each other. The students soon find out that they are much in demand by faculty members, who are eager to have them for projects. This also motivates them to put in the long hours required by the challenging programme.

The committee is convinced that this limited group size is indeed very essential for the success of the programme. The positive and excellent spin-off features arise mainly from this limited group size: social coherence, group dynamic, peer-to-peer, intensive guidance by teachers/ researchers, et cetera. According to the committee, it is difficult to determine whether the same effect can be achieved with a group size of twenty students. However, it is of the opinion that the positive effect of the group size will definitely decrease if there are more than twenty students.

2.1.8. Teaching personnel

The committee established during the site visit and according to the information in the critical reflection that the programme has been designed by active and excellent world-class researchers in Nanoscience. These researchers convey to the students the knowledge, skills, attitude, and ethics needed for an independent research career. This means that all participating teachers are full-time tenured (or tenure-track) faculty members of the Zernike Institute for Advanced Materials, and active and excellent researchers in the field of Nanoscience. According to the critical reflection, they jointly cover the full breadth of the field of Nanoscience.

During the interviews students and alumni made it clear that they are very satisfied with the knowledge and expertise of the researchers they are working with. The same applies for the way that the students are guided by the researchers. Students indicate that the researchers provide very intense and professional guidance. They expressed their overall satisfaction with the researchers thus: "They are very excellent researchers, with very well developed didactic skills."

The students and alumni described their contact with the researchers as excellent. They say that the researchers are very open to receiving feedback and ensuring appropriate measures are put into effect immediately if necessary. This was confirmed during the interviews several times, by both students and alumni as well as by the researchers themselves. Students say that the researchers frequently ask them for their opinion of the curriculum, the teaching concept, the materials provided, the facilities and the actual education they receive. Apart from the structural evaluation after a specific module, that is part of the more informal quality assurance policy of the programme.

The committee established that, according to the students and alumni, most researchers keep the distance between themselves and the students as small as possible. Students find the researchers therefore very accessible and approachable. They say that they feel free to ask them questions and contact them whenever they are in need of support. Therefore, there is a lot of personal contact between the researchers and the students. Students, alumni and researchers call themselves "a very cohesive group". According to the researchers and the alumni, the contact between researchers and students remains even after students finish the

master programme and especially if any student continues with a PhD programme at the Zernike Institute.

The committee is very impressed by the knowledge, expertise and attitude of the teaching staff. It is convinced that they are highly qualified, highly motivated and very willing to interact with students. They also have a highly developed personal view on topics concerned with Nanoscience, with a clear eye for numerous important details.

2.1.9. Quality assurance

The committee established that the small scale of the programme allows a more detailed evaluation of all courses than already provided by the university's standard course assessment forms.

Both students and alumni indicate that the majority of feedback and, in addition, adaptation of the content of the courses already occurs during the provision of the courses. This is because there is so much direct interaction between students and researchers, allowing tailored solutions to be implemented immediately.

Furthermore, twice each year, a lunch meeting is held with all students of each year to discuss any problems they have experienced with the courses. Outcomes of this meeting are communicated directly to the faculty members involved by the chair of the Course Committee and the programme co-coordinator.

Considerations

The committee established during the site visit that the Institute has used all the unique aspects of the master's programme in Nanoscience to maximum advantage in building up a quality educational programme that provides a highly challenging and motivating environment in which students are offered an excellent opportunity for education in Nanoscience. The committee is convinced that this programme exemplifies 'best practice'. The personnel and facilities are excellent, the cohorts of students are very small, the entrance to this programme is highly selective, and the curriculum is outstanding. Students are given the unique opportunity to participate in a world-class research institute. They carry out part of their master's thesis projects in nationally and internationally leading research groups. The contacts with these research groups are usually made by the direct supervisors of the students. The student is requested to apply for funding as part of the training. Therefore, the educational programme provides a challenging and motivating environment in which a select group of students is offered a first-rate and unique opportunity for education in Nanoscience.

The committee is impressed by these unique aspects of the master's programme. In contrast to regular master's programmes, it is convinced that the ambition and intentions of this particular programme are definitely much higher. In regular master's programmes there is less emphasis on research training, and the cohorts of students are much larger. In contrast, the Groningen programme in Nanoscience is a very high-level degree course with a strong emphasis on research training and a very demanding curriculum for a select group of students that is able to handle this challenge.

The programme aims at an interdisciplinary training in modern materials science, with a focus on nanoscale phenomena. The committee is highly impressed by the coherence and construction of the curriculum, with an excellent interaction between chemistry and physics, with very relevant course content contributed by both of these disciplines. The management intends to implement more bio-related aspects in the curriculum and strongly desires to

attract a new staff person who could provide the necessary expertise to cover the area of bio-related aspects. Pending the arrival of this expert, the management has already implemented several bio-related aspects in the curriculum. The committee highly appreciates this decision by the management to incorporate bio-related aspects urgently into the curriculum and encourages the programme to continue its efforts in this regard.

The committee established during the site visit that since the programme is aimed at a career path in research, the intended qualifications are strongly focused on the academic skills that are demanded by the international scientific community in Nanoscience. It is therefore convinced that the requirements for a university master's degree course are absolutely fulfilled and comparable with the best educational institutes on an international level. The same applies to the curriculum. Knowledge, skills and awareness of the social context needed for a research career in nanoscience are present in the curriculum. The programme guarantees its students in-depth research experience with a solid academic basis. It provides them with the communication skills needed to perform at an international level.

One of the most unique characteristics of the programme is an extremely demanding intake based on excellent criteria and rigorous selection. This selection is necessary because the programme offers such a very challenging curriculum that only a select group of students is able to handle it.

The committee established during the site visit that the study load of this highly demanding and challenging programme is heavy, but feasible. As stated by the students and alumni, the study load is high but doable. In the end, the completion rates are extremely high.

Teachers and supervisors associated with the programme are drawn from the excellent research groups contributing to the Zernike Institute research programme and form excellent role models for the students. High-quality staff members cover the necessary areas of Nanoscience and possess outstanding research and teaching abilities. The committee is convinced that there is an optimum ratio of students and staff which results in a very intense, positive and effective interaction where feedback is well received. During the site visit students and alumni made it very clear that there is an outstanding guidance and tutoring system.

Conclusion

Master's programme Nanoscience: the committee assesses Standard 2 as **excellent**.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This standard presents the findings regarding the system of assessment and evaluation (3.1.1), and then the question is addressed of whether students actually realize the targeted final qualifications of the programme (3.1.2).

3.1.1. The system of assessment and evaluation

During the site visit the committee ascertained whether the programme has an adequate system of assessment and scrutinized several representative tests and assessments. It concluded that there is a very good system in place and that the tests and assessments are valid, reliable and transparent.

Methods of assessment

The committee established during the interviews and according to the information in the critical reflection document that the method of assessment of each component is well 'matched' to the nature of that component. The taught courses and the electives are assessed through written exams. The other components (the research projects, the paper and the research proposal) are independently assessed by two faculty members: the daily supervisor and the coordinator of the component.

The assessment methods are laid down in the Teaching and Examination Rules (OER). They comply with the University's rules and policy for assessment. Exams are graded within ten working days. A student has the right to inspect the marked work.

The teaching methods and assessment methods are explained to the student in the course descriptions in Ocasys. The committee established during the site visit that the expected outcomes are clearly evident, and students can choose an effective preparation strategy. Students, alumni and teachers confirm this by stating that every core module starts with an introduction about the aims (intended learning outcomes), the content and the way the course will be examined or assessed. After every course the exams are evaluated. Students feel that the teaching staff takes this feedback very seriously and that, if necessary, the exam is adjusted. For example, one exam consisted of very detailed questions in contrast to what was discussed/taught during the lectures. After students mentioned this in the evaluation, the teacher made several changes (in weight and in content).

The committee looked at different tests and assessments. It established that they are excellent in terms of level and content. In addition, it verified that the assessments are sufficiently varied, well considered and attuned to course aims. Therefore, it is convinced that the system of assessment and evaluation is well constructed and functioning very well.

Thesis process

The critical reflection document indicates that at the start of the master's thesis project, a plan is made. Progress is checked regularly in meetings to prevent unnecessary delay in the project. The daily supervisor of the master's thesis project is responsible for providing a realistic project and for monitoring the progress. During the interviews, researchers, students and alumni made it clear that students may choose a topic for their master's theses from a list of topics of the research groups. During the programme, students acquire a very good picture of the themes and topics the various research groups are working on. The students discuss the topic(s) they are interested in with their daily supervisors.

The OER states that the small research project and the master's thesis project cannot be carried out in the same research group. Furthermore, the small research project, the master's thesis project and the scientific paper cannot be on the same topic nor supervised by the same person. The OER states as well that the assessment of a final degree project (thesis or research projects/internships) takes place within a general assessment framework. The supervisors (at least two) who have been appointed as examiners by the Board of Examiners

will determine the mark together. If necessary, they will consult an external supervisor.

Students and alumni confirm this and indicate that, regarding the master's thesis, it is clear in advance what the outcome should be, what the assessment criteria are, and the way counseling and assessment will take place. During the small research project, students become acquainted with the assessment procedure and criteria which are also used during the master's thesis project.

The committee established during the site visit that there is a clear system and procedure of assessing the master's theses. The assessment form contains an excellent set of evaluation criteria. The committee is very pleased with the assessment criteria.

Board of Examiners
The programme's Board of Examiners monitors the quality of the programme to ensure that students achieve the final attainment levels. As of 1 September 2010 an increase in the responsibilities of the Board of Examiners has been laid down by law; the Board of Examiners became responsible for monitoring the quality of the examinations and final exams. Both the University of Groningen and the Faculty of Mathematics and Natural Sciences described how the Board of Examiners should take up this responsibility.

The management of the programme, together with the Board of Examiners, has started to work out these new legal terms of reference. The main focus of the Board is to take its legal role very seriously and actualize the intended measures quickly, in order to implement its statutory functions in practice.

However, in addition to the intentions of the Board of Examiners, the committee is convinced that the Board is already functioning very well at present. It is seriously concerned with quality assurance and is already proactively involved in improving procedures to maintain a high quality. This is very much helped and enhanced by the group size of the cohorts and the direct and intensive interaction with the students.

3.1.2. Achievement of the learning outcomes
According to the critical reflection, the best indicator that students achieve the intended learning outcomes of the programme can be measured by the extremely high completion rates. Of the 47 students who have graduated so far, 46 have gone on to a PhD degree, either at the University of Groningen or at prestigious universities elsewhere (Leuven, Cambridge, Delft, Twente, and Amsterdam). Most of the graduates received several offers for a PhD position because they have a highly desired profile for research positions.

The committee is convinced that the achieved learning outcomes are excellent. In order to be able to judge the students' final attainment level, it asked for fifteen theses (see Appendix 7) in advance. In preparation for the site visit, it discussed its findings of these theses. It was really impressed by their high level. In general, it agreed with the grades awarded by the supervisors. In some cases it even gave higher grades, and only in one case a slightly lower grade.

Considerations
The committee established that the assessment system of the programme functions very well. The examination structure has clearly been tailored to the intended learning outcomes of the programme. There is a very large variety of assessment methods. The committee has verified the tests and assessments and is convinced that they are valid, reliable and of very high quality

in terms of level and content. The assessment system is also very transparent: the students know what is expected from them. They also appreciate the high level of requirements they have to fulfill. Good control mechanisms seem to ensure that work is systematically and consistently graded. And after each assessment students give their feedback, on the basis of which adjustments are made when this proves to be needed. This assessment system contributes greatly to making this master programme unique. It certainly contributes to the high level achieved by the students.

The committee noted during the site visit that there is a very clear system of assessing the master's theses as well. It established that it is clear in advance what the outcome of the master's thesis should be, what the assessment criteria are, and the way counseling and assessment take place. Students already experience this during the small research project.

The committee is really impressed by the very high quality of the master's theses it studied and got a general impression of high standards for graduation. It scored most of the theses similarly to the grades the supervisors awarded the students, ranging from good to excellent. It is therefore convinced that the learning outcomes are being achieved at an excellent and high level. The graduates seem to have a broad range of possibilities to continue their research activities on a high level. The examples the committee saw were very impressive.

According to the committee, the Board of Examiners is functioning excellently. It is concerned with quality assurance and is proactively involved in improving procedures to maintain a high level of quality.

Conclusion
Master's programme Nanoscience: the committee assesses Standard 3 as **excellent**.

General conclusion

The committee has examined what it regards as a very impressive and unique master's programme. It spoke to very enthusiastic and highly motivated students, who are very proud to be enrolled in this programme, and to excellent researchers who guide them in an extraordinary manner in the newly emerging field of Nanoscience, through a very demanding and high-level curriculum, which is greatly enhanced by excellent facilities. Although there are some weak points in the assessment system in the Faculty of Mathematics and Natural Sciences according to information give to the committee after the completion of their assessment, the committee did not find any such weaknesses in the assessment system of this particular master's programme.

Conclusion
The committee assesses the *master's programme Nanoscience* as **excellent**.

Appendices

Appendix 1: Curricula Vitae of the members of the assessment committee

Frans De Schryver (1939) obtained the degree of doctor in sciences in 1964. At the Katholieke Universiteit Leuven he was appointed lecturer (1969), professor (1973) and full professor (1975). He became emeritus professor in October 2004. He has been involved in the area of photochemistry and photophysics for many years. His research has focused on fundamental aspects of photochemistry and photophysics and their use in the study of physicochemical properties of complex systems. During the last 15 years he contributed primarily to the emerging field of time and space resolved (photo)chemistry and nanoscience including scanning probe microscopy, optical microscopy and single molecule spectroscopy. He has published over 660 paper in peer reviewed journals. He was a visiting professor in many Universities and held appointments as a long time associate at the Université Catholique de Louvain and Stellenbosch University. He is a member of the Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten and was president of the Klasse van de Natuurwetenschappen (2002). He received a Fulbright Research Fellowship in 1964, he was a Laureate of the Belgian Koninklijke Academie voor Wetenschappen, a Senior Research Awardee of the Alexander von Humboldt Foundation in 1993. He is Editor in chief of Photchemical and Photobiological Sciences and evaluator for the ERC, DFG, AERES, ANR, the Swedish research Council, MUIR. He has been chair of the Dutch committee that assessed the research programmes in chemistry of the technical universities in 2009 and the other universities in 2010.

Jacqueline Hellemans (1942) studied Physics at the University of Leuven (KU Leuven) and became a Master of Science in 1964. She subsequently received her Ph. D. in Physics from the same university in 1971. In 1981 she became Master in Medical Sciences at the KU Leuven. Professor Hellemans is professor emeritus at the Departement of Physics and Astronomy of KU Leuven and was involved in the training programme for academic teachers of the same university until her retirement (October 2007). Her research topics are: Physics of fluids, Medical physics and Physics Education. She taught General Physics and Mathematics for 1st year Bachelor's medical students and General Physics for 1st year Bachelor's students in Physical Education. She designed experiments for 2nd year Master's students and taught Didactics of Physics in the Teachers' training programme for 1st and 2nd year master students Physics. Furthermore, professor Hellemans was involved in the in-service training of Physics teachers. From 2005 to 2007 she was a member of the 'Raad voor Betwistingen inzake Studievoortgangsbeslissingen'. She was a member of the committee that assessed the Master's programme Nanoscience of the University of Groningen in 2007 and of the committee that assessed the programmes in Industrial Design Engineering of the universities of Delft, Twente and Eindhoven in 2007.

John McGarvey (1939) studied Chemistry at Queen's University Belfast. He obtained his Ph.D. in Physical Chemistry in 1964. Since 1969, he held various positions at Queen's University Belfast. In 1978, he was a visiting professor at the University of Leuven. In 1995, he was William Evans Visiting Fellow at the University of Otago, New Zealand. He held a Chair in Physical Chemistry in the School of Chemistry at Queen's University Belfast from 1995 until his retirement in September 2005. He is currently an Emeritus Professor of Chemistry and Visiting Research Professor. He held a Leverhulme Emeritus Research Fellowship (2006-08) at Queen's University. He is also an honorary member of staff in the Centre for Vision & Vascular Sciences (CVVS). His research interests are in the laser photochemistry, photophysics and time-resolved vibrational spectroscopy of metal-centred

species, and, currently, in Raman microscopy applied to biomedical systems. He coordinated the School of Chemistry's successful submission on UG and PG teaching (December 2004) as part of the University's Institutional Audit carried out by the UK Government's Quality Assurance Agency.

Alexandre Revcolevschi (1940) obtained a degree in Engineering of the Ecole Nationale Supérieure de Chimie de Paris (ENSCP). He obtained a Ph.D. from the University of Paris 11 (Orsay) in 1969. He was 1975 visiting scientist at MIT (Cambridge, USA) in 1970-1971, Chargé de recherche (1971-1975) and Directeur de recherche (1975) at CNRS/Centre de recherches de chimie métallurgique (CECM), Vitry sur Seine. Since 1976, he has been a professor in solid state chemistry at the University of Paris 11 (Orsay). He was Director of the Laboratory of solid state chemistry (1976-1990), director of the Laboratory of thermodynamics and physical chemistry of materials (1990-1998) director of the Laboratory of solid state physical chemistry (1998-2005) and dean of science and director of the research (2005-2009) at the same university. Since 2009, he is emeritus professor. He is author or co-author of 580 scientific articles and referee of various international scientific journals. His research interests include solid state chemistry, non-stoichiometry, phase diagrams, crystallography, crystal growth theory and technology, materials science and metallurgy.

Andreas Wieck (1958) studies Physics at the University of Hamburg and received his degree in 1984. He conducted experimental PhD work at the High Magnet Field Laboratory (Grenoble) of the Max Planck Institut für Festkörperforschung in Stuttgart. He obtained his Ph.D. from the University of Hamburg in 1987. From 1987 until 1993, he worked as a post doc at the Max Planck Institut für Festkörperforschung in Stuttgart. In 1992 – 1993, he took a sabbatical in the NTT basic research labs Tokyo (Japan). Since 1993, he has been full professor in applied solid-state physics at the Ruhr-Univesität Bochum. From 2000 until 2002, he was Dean of the Faculty of Physics and Astronomy. From 2002 until 2004, he was vice-dean of the same faculty. In 2004-2005, he was appointed by the CNRS (Paris) as a *directeur de recherche* at the CHREA in Sophia Antipolis (France). In 2007–2008 and 2011–2012, he had sabbaticals at this CHREA Sophia Antipolis. In 1990, professor Wieck received the Philip Morris Prize for the invention of the "In-Plane-Gate-Transistor". His research interests are IIIV-Molecular Beam Epitaxy (MBE), Focussed Ion Beams, low dimensional quantum systems and nanoelectronics. Prof. Wieck runs one of the most performant MBE-groups in Germany, with cooperations worldwide. He holds more than 500 peer-reviewed papers in international journals. His chair group produced more than 40 PhDs.

Pim Muilwijk (1988) holds a B.Sc. degree in Advanced Technology of the University of Twente. He is currently following the master's programme in Nanotechnology of the same university. In 2009-2010, he contributed to the development of an algorithm for a technological company that produces integrated electronics. In 2011-2012, he was editor of a national design competition for the University of Twente (the Eureka!Cup). He was a member of the programme committee Nanotechnlogy from 2010 until 2012. In addition, he held various positons in the study association S.V.A.T. Astatine. He also developed and maintains several websites.

Appendix 2: Domain-specific framework of reference

Nanoscience is the study of matter at scales below 100 nanometer. Many of the properties of matter at such scales differ dramatically from those at "everyday" scales. Both the possibility of exploiting such phenomena and the wish to understand how nature uses them are driving researchers in this field. A good introduction to the field of nanoscience (and its application-oriented sister, nanotechnology) is given in: Nanoscience and nanotechnologies: opportunities and uncertainties. Science Policy Section, Royal Society, London, 2004. ISBN 085403 6040.

Nanoscience is a relatively young field (its name is derived from the Greek word for dwarf.) It unites approaches from physics and chemistry and, increasingly, molecular biochemistry and biophysics. As such, it is truly an interdisciplinary field.

Given the young age of nanoscience, it is not surprising that no consensus exists yet about the precise delineation of the field. There are other universities that offer programmes in nanoscience, but no standardized curriculum or even agreement about the core competences required of its graduates exists.

The Zernike Institute for Advanced Materials is one of the world's leading research establishments in this emerging field. It unites top researchers with a variety of backgrounds, physics, chemistry, biophysics and biochemistry being the most prevalent. Experience over the last decades has shown that new breakthroughs occur especially at the interfaces between these original disciplines.

The Top Master Programme in Nanoscience was founded by the Zernike Institute to educate the next generation of researchers in nanoscience. It was believed that a solid background in those parts of physics and chemistry that form the core of nanoscience would provide the graduates of this programme with a good starting position in world-class research. The Top Master Programme is aimed at exceptionally gifted students, who wish to become the future leaders in nanoscience research. The Master Programme is designed as preparation for a PhD position.

Nanoscience is a very broad field. Given the limitation of two years for a master's degree programme, choices will have to be made. Lacking an international consensus about a core curriculum in nanoscience, the Zernike Institute bases its choice simultaneously on the competences it has "in house" through its researchers and on the requirements posed by its various research projects. As the Zernike Institute covers a very broad spectrum of approaches to nanoscience, this choice ensures that alumni of the Top Master Programme will not only be eminently suited for PhD positions in the Zernike Institute itself, but also for ones in leading nanoscience research centres elsewhere. The experience of the cohorts of graduates so far confirms the appropriateness of this approach.

The research within the Zernike Institute for Advanced Materials covers the whole chain from modelling and designing through synthesis of materials, their characterization, and making devices, whether experimentally, theoretically, or computationally. The Zernike Institute is almost unique in this respect. The curriculum reflects this wide span and ensures that alumni have a solid grasp of the whole chain.

Linking the contents of the curriculum to the research programme of the Zernike Institute also ensures that new developments in the field are quickly incorporated into the courses. The

gradually increasing involvement of the Zernike Institute in biological or bio-inspired research projects is thus automatically reflected in the curriculum.

To further guarantee that the choice of subfields from nanoscience for the curriculum of the Top Master Programme is not too parochial, feedback from the International Advisory Panel (IAP) of the Zernike Institute is used. The seven IAP members all work at world-class research establishments and represent potential employers of the graduates of the Top Master Programme. In addition, we systematically ask our graduates who have gone to PhD programmes elsewhere whether their training at the Top Master Programme has prepared them well for their position. They invariably answer affirmatively to this question.

Appendix 3: Intended learning outcomes

The intended learning outcomes of the master programme in Nanoscience can be summarized as follows.

The graduate of the master programme in Nanoscience:

- has recent and profound knowledge of those parts of the disciplines of physics, chemistry, molecular biology, and mathematics that are relevant to nanoscience;
- is able to apply this knowledge to solving realistic scientific problems in nanoscience, even on the basis of a rudimentary problem specification;
- is capable of acquiring within a limited time span sufficient knowledge to work successfully in a different speciality within nanoscience;
- is capable of critically using the scientific literature in his/her chosen speciality;
- is capable of performing scientific experiments and of interpreting their results;
- can effectively convey results of scientific research, orally and in written form, to specialists as well as non-specialists;
- is capable of working independently;
- can co-operate successfully in a research team;
- can formulate and defend a realistic and well-argued research plan on the basis of a rudimentary problem specification;
- is aware of the social and ethical ramifications of scientific research and its applications;
- is able to adapt to the rapid changes occurring in the field of nanoscience;
- has the motivation, knowledge and skills to successfully enter a PhD programme in any of the world's leading research institutes in nanoscience.

The intended learning outcomes of the master programme in Nanoscience are in complete accordance with the so-called Dublin descriptors for master awards. In the following list, the five aspects of intended learning outcomes considered by Dublin descriptors for the master degree are given. In Appendix 4, these are linked to the various components of the curriculum.

1. ["know"] have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with Bachelor's level, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;
2. ["apply"] can apply their knowledge and understanding, and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
3. ["integrate"] have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;
4. ["communicate"] can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;
5. ["learn"] have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

Appendix 4: Overview of the curriculum

The first year consists of self-study, lectures, exercises, research, and oral and written presentations, as follows:

- Weeks 1 to 5 are for Guided self-study (6 EC).
- Weeks 6 to 23 are reserved for the core modules (Preparation of nanomaterials and devices, Characterization of nanomaterials, Fundamental and functional properties of nanomaterials; in total 30 EC), comprising the core knowledge of nanoscience.
- Weeks 24 to 42 are for electives (14 EC for the programme as a whole, spread over the first and the second year). In this period, students also write a paper (6 EC) and carry out a small research project culminating in an oral presentation at a symposium (13 EC) organized by the students themselves.

The second year concentrates on the remaining electives, the thesis project (45 EC) and writing a PhD research proposal (6 EC).

The relations between the intended learning outcomes of the curriculum and the components of the curriculum are summarized in the following table.

	Know	*Apply*	*Integrate*	*Communicatie*	*Learn*
NS000 Guided self-study	XXX				X
NS001, 002, 003 Core modules	XXX				
Electives	XXX	X			
NS190 Paper	XXX			XXX	X
NS194 Small research project	X	XXX	X	XXX	
NS200 PhD-Research proposal	X	X	XXX	XXX	XXX
NS202 MSc-thesis project	X	XXX	XXX	XXX	X

Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Data on intake, transfers and graduates pertaining to the last six cohorts:

Cohort	Students entering the programme	Of whom female	Ratio Dutch / foreign students	Students graduating in <= 2 yrs	Of whom *Cum laude*	Students graduating <=3 yrs	Students continuing towards a PhD
2006-2008	7	2	2/5	7	4	7	6
2007-2009	3	1	0/3	1	0	3	3
2008-2010	7	0	1/6	7	4	7	7
2009-2011	13	2	5/8	12	6[1]	13	13
2010-2012	9	4	4/5	Ongoing	n.a.	n.a.	n.a.
2011-2013	15	3	5/10	Ongoing	n.a.	n.a.	n.a.

[1] Of whom one received *Summa cum laude*, a distinction that was not available in earlier years.

Teacher-student ratio achieved

During the Core Modules, the students encounter some fifteen staff members as teachers, all scientific staff members of the Zernike Institute and active researchers. During the electives, they may meet other staff members as well. During the lab sessions, they additionally meet the technical support staff. None of these staff members is exclusively assigned to the Top Master Programme in Nanoscience; they are also involved in the regular BSc and MSc programmes in chemistry and physics (and for some: in others programmes as well).

To help the students find their way through the organisation, each student is assigned a senior staff member as his/her mentor. The intensity and frequency of the contacts with the mentor vary, as a function of the student, the mentor, and the problems encountered, but the aim is to have one (possibly brief) meeting per two weeks. The contacts with the technical staff and with the scientific staff in their mentor role are not included in the teacher-student ratio below.

For full professors, the Faculty of Mathematics and Natural Sciences assumes that 40% of their time is spent on teaching. During this time, they give approximately four courses of 5 EC each. The course load of 60 EC per year thus requires the equivalent of three teachers. With an average number of students of twelve per cohort, this gives a ratio of one full-time staff member per four students.

(A more detailed calculation, taking into account the differences between lectures, tuturials, and lab exercises, using FWN-wide standardized numbers, gives one full-time staff member per 4,22 students.)

Average amount of face-to-face instruction per stage of the study programme

During the various phases of the curriculum, the average amount of face-to-face instruction is as follows:

- Guided self-study: depending on the assigned topic, the number of contact hours varies from 2 to 6 per week.
- Core Module NS001: 68 hours of lectures; 32 hours of lab exercises; 12 hours of tutorials; 4 hours Q-A-session.
- Core Module NS002: 60 hours of lectures.
- Core Module NS003: 90 hours of lectures; 10 hours of tutorials; 12 hours of lab exercises.

This means that during the weeks the Core Modules are taught, the students have approximately 20 hours of face-to-face instruction per week.

Electives: for each elective, about 32 hours of lectures and practicals. Most students take four electives, giving about 128 contact hours in total. The electives are spread over the second half of the first year and the whole of the second year.

During the components small research project, scientific paper, MSc thesis project, and PhD proposal writing, the number of contact hours on average is roughly 3 per week (although the concept of "contact hour" is somewhat hard to quantify during "hands-on training").

Appendix 6: Programme of the site visit

Programme for the site visit master programme in Nanoscience. The full names of the participants in the site visit of the master programme are on the next page.

Tuesday 18 September 2012

Arrival of committee members, instruction of the committee.

Wednesday 19 September 2012

09:00 – 12:00 Committee meeting

12:00 – 13:00 Management: Knoester (Dean), Palstra (Academic Director), Van der Wal (Chair, Course Committee and Board of Examiners), Van Loosdrecht (former Chair, Course Committee and Board of Examiners), Mars (Coordinator)

13:00 – 13:45 Lunch

13:45 – 14:45 Current students: Driest, Gurran, Shan, Shulga, Torabi, Eric de Vries

14:45 – 15:30 Co-ordinating teachers of Core Modules: Rudolf, Pchenitchnikov, Van Loosdrecht, Van der Wal

15:30 – 15:45 Break

15:45 – 16:15 Open office hour / tour of the facilities

16:15 – 17:00 Alumni: Wojtaszek, Dejene, van Abswoude, de Gier, Gordichuk, Turkin

17:00 – 17:30 Course Committee: Van der Wal, Noheda, Broer (representing van der Giessen), Balázs, Doumon, Perdok, Mars

17:30 – 18:15 Board of Examiners: Van der Wal, Broer (representing van der Giessen), Noheda, Mars

19:00 Dinner

Thursday 20 September 2012

09:00 – 10:15 Committee meeting

10:15 – 11:00 Management: Palstra, Van der Wal, van Loosdrecht, Mars

11:00 – 13:00 Committee meeting / lunch

13:00 – 13:45 Oral presentation of preliminary findings

Full names of the participants in the site visit of the master programme in Nanoscience

- **Aisha Aqeel,** MSc, alumna, cohort 2010-2012, now PhD student at Zernike Institute
- **Dániel M. Balázs**, Top Master student, cohort 2011-2013; Member of the Course Committee
- **Prof. R. Broer**, Theoretical chemistry. Former member of the Course Committee and of the Board of Examiners (representing Prof. E. van der Giessen, current member of these committees)
- **Fasil Dejene,** MSc, alumnus, cohort 2008-2010, now PhD student at Zernike Institute
- **Edmond Doumon**, Top Master student, cohort 2011-2013; Member of the Course Committee
- **Piet Driest**, Top Master student, cohort 2011-2013
- **Hilde de Gier,** MSc, alumna, cohort 2009-2011, now PhD student at Zernike Institute
- **Pavlo Gordiichuk,** MSc, alumnus, cohort 2009-2011, now PhD student at Zernike Institute
- **Mallik Gurram**, Top Master student, cohort 2011-2013
- **Prof. J. Knoester**, Theory of condensed matter physics, Dean of the Faculty of Mathematics and Natural Sciences
- **Prof. P.H.M. van Loosdrecht**, Optical condensed matter physics. Former Chair of the Course Committee and of the Board of Examiners. Former coordinator of Core Module.
- **Dr. N.J.I. Mars**, Research manager of the Zernike Institute and Coordinator of the Top Master Programme in Nanoscience
- **Prof. B. Noheda Pinuaga**, Solid-state materials for electronics. Member of the Course Committee and of the Board of Examiners
- **Prof. T.T.M. Palstra**, Solid-state materials for electronics. Scientific Director of the Zernike Institute; Academic Director of the Top Master Programme in Nanoscience
- **Dr. M.S. Pchenitchnikov**, Optical condensed matter physics. Coordinator of Core Module NS002
- **Diederik Perdok**, Top Master student, cohort 2011-2013; Member of the Course Committee
- **Prof. P. Rudolf**, Surfaces and thin films. Coordinator of Core Module
- **Juan Shan**, Top Master student, cohort 2011-2013
- **Artem Shulga**, Top Master student, cohort 2011-2013
- **Solmaz Torabi**, Top Master student, cohort 2011-2013
- **Alex Turkin,** MSc, alumnus, cohort 2009-2011, now PhD student at Zernike Institute
- **Eric de Vries**, Top Master student, cohort 2011-2013
- **Prof. C.H. van der Wal**, Physics of nano-devices. Chair, Course Committee and Board of Examiners; Coordinator of Core Module NS003
- **Magdalena Wojtaszek,** MSc, alumna, cohort 2007-2009, now PhD student at Zernike Institute

Appendix 7: Theses and documents studied by the committee

Prior to the site visit, the committee studied the theses of the students with the following student numbers:

Cohort 2008-2010
1810324
1842552
1813293
1802208
1802321

Cohort 2009-2011
1946072
1605887
1631497
1951246
1947141
1565036
1951068
1951963
1615831
1951319

During the site visit, the committee studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Content and exams of Core Module 1 (NS001): for the Core Modules (NS001, NS002, and NS003) the course description, the syllabus, PowerPoint slides, examples of exam questions, and examples of graded exams were made available and studied by the committee.
- Summary of student evaluations of Core Module NS001, NS002 (2011-2012)
- Brief assessments of the Top Master Programme in Nanoscience by alumni
- Students' comments on first year of cohort 2011-2013

Appendix 8: Declarations of independence

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ONAFHANKELIJKHEIDS- EN GEHEIMHOUDINGSVERKLARING

INDIENEN VOORAFGAAND AAN DE OPLEIDINGSBEOORDELING

ONDERGETEKENDE

NAAM: Frans De Schryver

PRIVÉ ADRES: Minnezang 9 B-3210 Linden (Lubbeek) Belgie

IS ALS DESKUNDIGE / SECRETARIS GEVRAAGD VOOR HET BEOORDELEN VAN DE OPLEIDING:

Nanoscience

AANGEVRAAGD DOOR DE INSTELLING:

Rijksuniversiteit Groningen

VERKLAART HIERBIJ GEEN (FAMILIE)RELATIES OF BANDEN MET BOVENGENOEMDE INSTELLING TE ONDERHOUDEN, ALS PRIVÉPERSOON, ONDERZOEKER / DOCENT, BEROEPSBEOEFENAAR OF ALS ADVISEUR, DIE EEN VOLSTREKT ONAFHANKELIJKE OORDEELSVORMING OVER DE KWALITEIT VAN DE OPLEIDING TEN POSITIEVE OF TEN NEGATIEVE ZOUDEN KUNNEN BEÏNVLOEDEN;

1

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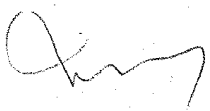
VERKLAART HIERBIJ ZODANIGE RELATIES OF BANDEN MET DE INSTELLING DE AFGELOPEN VIJF JAAR NIET GEHAD TE HEBBEN;

VERKLAART STRIKTE GEHEIMHOUDING TE BETRACHTEN VAN AL HETGEEN IN VERBAND MET DE BEOORDELING AAN HEM/HAAR BEKEND IS GEWORDEN EN WORDT, VOOR ZOVER DE OPLEIDING, DE INSTELLING OF DE NVAO HIER REDELIJKERWIJS AANSPRAAK OP KUNNEN MAKEN.

VERKLAART HIERBIJ OP DE HOOGTE TE ZIJN VAN DE NVAO GEDRAGSCODE.

PLAATS: Linden DATUM: 3/03/2012

HANDTEKENING:



Q393

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DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: JACQUELINE HEIJEMANS

HOME ADDRESS:

BANTHAGESTRAAT 107
D-30172 HANNOVER

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

Nano science

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

Rijksuniversiteit Groningen

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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nederlands-vlaamse accreditatieorganisatie

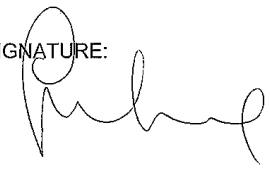
HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Groningen DATE: 20/9/2012

SIGNATURE:



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nederlands-vlaamse accreditatieorganisatie

DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: JOHN McGARVEY

HOME ADDRESS: 13 CHURCH AVE
DUNMURRY
BELFAST BT17 9RS UK

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

Nanoscience

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

Rijksuniversiteit Groningen

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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nederlands-vlaamse accreditatieorganisatie

HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: DATE: 20.09.12

SIGNATURE:

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DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Alexandre REVCOLEVSCHI

HOME ADDRESS: 27 route de la Reine
92100 Boulogne - FRANCE

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / ~~SECRETARY~~:

Master's programme in nanoscience of the University of Groningen

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

Univ. of Groningen

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

I have been having a research collaboration with a group* of this University for more than ten years, but this will not affect my independence concerning education programs evaluation

* optical condensed matter physics

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HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

see above

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: ~~DRSAY~~ DATE: 16/6/12

SIGNATURE:

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DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Andreas Wieck

HOME ADDRESS: Lehrstuhl für Angewandte Festkörperphysik
Universitätsstraße 150 NB03/58
D-44780 Bochum GERMANY

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Groningen DATE: 18-Sept.-2012

SIGNATURE:

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DECLARATION OF INDEPENDENCE AND CONFIDENTIALITY

TO BE SUBMITTED PRIOR TO THE ASSESSMENT OF THE PROGRAMME

THE UNDERSIGNED

NAME: Pim Muilwijk

HOME ADDRESS: Broekse weg 39
4233 CT AMEIDE

HAS BEEN ASKED TO ASSESS THE FOLLOWING PROGRAMME AS AN EXPERT / SECRETARY:

Nanoscience

APPLICATION SUBMITTED BY THE FOLLOWING INSTITUTION:

Rijksuniversiteit Groningen

HEREBY CERTIFIES TO NOT MAINTAINING ANY (FAMILY) CONNECTIONS OR TIES OF A PERSONAL NATURE OR AS A RESEARCHER / TEACHER, PROFESSIONAL OR CONSULTANT WITH THE ABOVE INSTITUTION, WHICH COULD AFFECT A FULLY INDEPENDENT JUDGEMENT REGARDING THE QUALITY OF THE PROGRAMME IN EITHER A POSITIVE OR A NEGATIVE SENSE;

1

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nederlands-vlaamse accreditatieorganisatie

HEREBY CERTIFIES TO NOT HAVING MAINTAINED SUCH CONNECTIONS OR TIES WITH THE INSTITUTION DURING THE PAST FIVE YEARS;

CERTIFIES TO OBSERVING STRICT CONFIDENTIALITY WITH REGARD TO ALL THAT HAS COME AND WILL COME TO HIS/HER NOTICE IN CONNECTION WITH THE ASSESSMENT, INSOFAR AS SUCH CONFIDENTIALITY CAN REASONABLY BE CLAIMED BY THE PROGRAMME, THE INSTITUTION OR NVAO;

HEREBY CERTIFIES TO BEING ACQUAINTED WITH THE NVAO CODE OF CONDUCT.

PLACE: Groningen DATE: 19-09-2012

SIGNATURE: