International Master Degree in Micro and NanoTechnology for Integrated Systems.
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ABSTRACT
In this paper we present the new joint Master Degree in Micro and Nano Technology for Integrated Systems (Master Nanotech) between the Grenoble Institute of Technology (INPGrenoble, France), the Politecnico di Turino (Italy) and the Ecole polytechnique de Lausanne (EPFL, Switzerland). The success of this new program relies both on its very specific syllabus and its international nature.

1. INTRODUCTION
Microelectronics is a strategic, dynamic and ever expending field, increasingly present in our everyday life. Strongly linked with microelectronics, microsystems (MEMS) and nanotechnologies are emerging fields of research and development that are rapidly expending while having their own identity and requiring evermore multi disciplinarily and strong basis in several scientific fields. The INPGrenoble, the Politecnico di Turino and the EPFL, have set up a joint « Master’s Degree in Micro and Nanotechnology for Integrated Systems » also called ‘Master Nanotech’[1].

2. OBJECTIVES AND COURSE SEQUENCE
The Master Nanotech is a versatile degree course dedicated to micro and nanotechnology, such that subsequent integration into the world of industry is facilitated at national or international level. It relies on the complementary skills of three leading European universities, in training and research in the sphere of micro and nanotechnology. Each year, 40 to 60 students are recruited from students at the INPGrenoble (ENSERG, ENSPG), the Politecnico di Turino and from the EPFL. To broaden the international nature of the master, the degree is also open worldwide to students from other universities, admitted according to their qualifications. The main goal of this master program is to produce engineers with a wide range and deep knowledge in microelectronics, MEMS, nanotechnologies, which are overflowing with applications in practically all sectors of the world economy. The syllabus (Fig.1) is composed of different courses necessary to implement system in package (SiP) and system on chip (SoC) technologies, plus advanced

![Figure 1. Syllabus for the 3 different semesters, at 3 different locations (Polytechnico di Torino in Italy, INPGrenoble in France, EPFL in Switzerland). The fourth semester is a training period in laboratories or industry.](image-url)
lectures in nanotechnologies and nanoelectronics. Students after spending a first semester in Italy, are welcomed in France during their second semester before going to Switzerland for their third semester. English is used for all courses. Professors from the different institutes have lectures in other institutes depending on the semester. The last semester is dedicated to a large project in industry or research laboratories, in Italy, France, Switzerland, or any other country.

3. SETTING UP THE MASTER: A UNIQUE CHALLENGE

To set-up the master, many meetings and correspondence between several actors of the different institutions were needed and required a lot of energy from everyone involved to satisfy every need and administrative problems. Attention was paid for the program to be well balanced along the different semesters between micro and nano-technologies, microsystems and nanotechnology, including the technological and design expertise needed for research and production. An extensive effort has been made for creating new courses [2] and laboratories [3] dedicated to this master: most of them were specifically set-up for the master. A strong effort was made on the coherence and continuity between the different lectures and practical courses, that required several meeting between the professors of the different institutions and many adjustments concerning the courses contents, duration, projects, etc. were made to offer a joint program. Those adjustments were also made during the first two years of the master in close link with the professors, students and industry partners. As an example, on top of a complete and coherent series of labworks (96 hours per student) that the students realize in INPGrenoble, tutored projects in teams of 4 to 8 students were introduced to highlight all the various aspects engineers face in their daily work to create a product. This experience is also helpful to prepare them to work on a project basis which is a scheme they will use at EPFL to design in common microelectronic analog and digital circuits. Other challenges arise from the fact that the master is run over several institutes and several countries with their own administrative peculiarities, education particularities, and different educative and notation systems that both the students and professors have to take into account.

4. CONCLUSIONS

The international dimension of this master and the variety and quality of the trainings and projects the students are involved in, play a key role in the success of this master. This master is very attractive and the selection of internal students is tougher every year, while the number and variety of worldwide applicants is ever-increasing. Strongly coupled both to the industrial preoccupations and advanced research activities, the program offers the students a unique knowledge on multiple scientific fields that includes microelectronics and microtechnologies, electronic circuits, physics, optics, nanotechnologies, biology, ... along with projects and many hands-on in clean room, bio- and nano-technology, commercial CAD software and training in the industry or academic research laboratories. With comparison to other programs that exists, this master is unique from many aspects: it goes all the way from micro/nanotechnology to integrated systems including MEMS, biotechnologies, with very rich and various hands-on, a specific program, plus a strong international nature. The first class graduated in September 2006. Even though it is quite early thus too early to make statistics about employment, most of the graduates have found a job in the industry (large and medium microelectronics companies, worldwide) or are currently pursuing a PhD in micro or nanotechnologies (Minatec-INPGrenoble, EPFL, CERN, ...). Students are very satisfied by the program and the contents of this master. They also appreciated much the different social and cultural identity of each country.

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6. REFERENCES