

Master of Science in Materials Science & Engineering

Prof. Fabien Sorin

29.02.2024

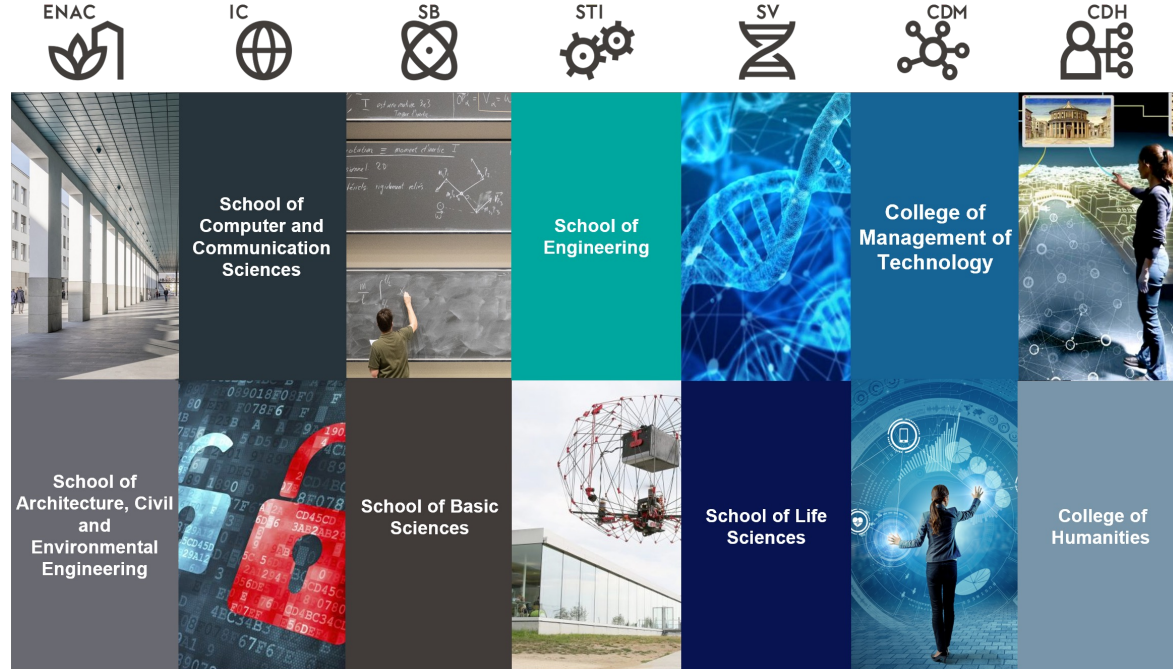


SMX and IMX@EPFL

Materials science

Master MX

- The SMX is part of the School of Engineering (STI)






















SMX in a few figures (2021)

- Number of students \approx **270** = 150 (BA) + 120 (MA)
- Number of staff: **391**
 - Professors and MERs: 26
 - PhDs: 177
 - The rest: postdocs, technicians, engineers...
- EPFL welcomes about **12000** students (10000 BA et 2000 MA)
- STI welcomes about **3000** students (1800 BA et 1200 MA)


















- 19 laboratories + 11 co-affiliations
- **42%** of laboratories are led by **women**
- 2 new laboratories this year



MORTENSEN Andreas	Mechanical Metallurgy Laboratory (LMM)	
SCRIVENER Karen	Laboratory of Construction Materials (LMC)	
KLOK Harm-Anton	Polymers Laboratory (LP)	
MISCHLER Stefano (MER)	Tribology and Interfacial Chemistry Group (TIC)	
FONTCUBERTA I MORRAL Anna	Laboratory of Semiconductor Materials (LMSC)	
FRAUENRATH Holger	Laboratory of Macromolecular and Organic Materials (LMOM)	
STELLACCI Francesco	Supramolecular Nano-Materials and Interfaces Laboratory (SuNMIL)	
MARZARI Nicola	Theory and simulation of materials (THEOS)	
SORIN Fabien	Laboratory of Photonic Materials and Fibre Devices (FIMAP)	
CERIOTTI Michele	Laboratory of Computational Science and Modelling (COSMO)	
LOGÉ Roland	Laboratory of Thermomechanical Metallurgy (LMTM)	
AMSTAD Esther	Soft Materials Laboratory (SMaL)	
GRUNDLER Dirk	Laboratory of Nanoscale Magnetic Materials and Magnonics (LMGN)	
TILELI Vasiliki	Laboratory for in situ Nanomaterials Characterization with Electrons (INE)	
MICHAUD Véronique	Laboratory for Processing of Advanced Composites (LPAC)	
BASTINGS Maartje	Programmable Biomaterials Laboratory (PBL)	
ABITBOL Tiffany	Sustainable Materials Laboratory (SML)	
LIEBI Marianne	Laboratory for X-ray characterization of materials (CAM-X)	
NATARAJAN Anirudh Raju	Laboratory of materials design and simulation (MADES)	

At the top in international rankings – 2023 QS ranking for Materials Science

1		Massachusetts Institute of Technology	USA
2		Stanford University	USA
3		University of Cambridge	UK
4		Harvard University	UK
5		University of California, Berkeley (UCB)	USA
6		Nanyang Technological University, Singapore (NTU)	Singapore
7		University of Oxford	UK
8		EPFL	CH
9		Imperial College London	UK
10		Tsinghua University	China
11		ETH Zurich	CH
12		National University of Singapore (NUS)	Singapore
13		Georgia Institute of Technology	USA
14		California Institute of Technology	USA
15		Northwestern University	USA

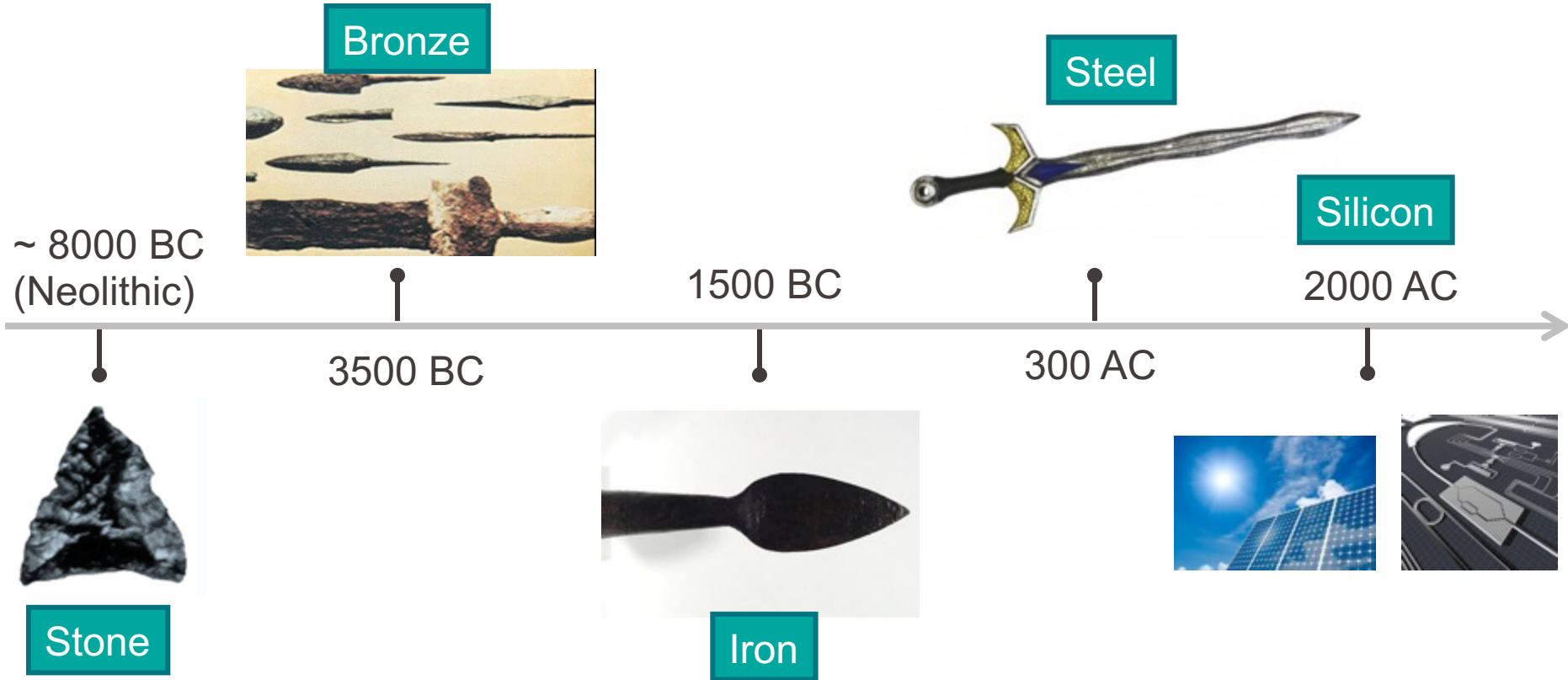


SMX and IMX@EPFL

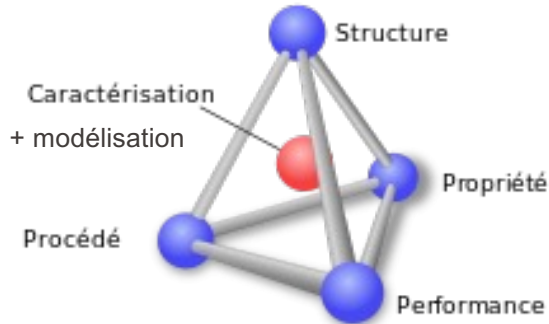
Materials science

Master MX

Materials: at the heart of technological revolutions



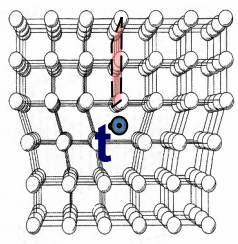
- **Materials science** allows the **design and development** of a material at the atomic scale (composition, structure), in order to obtain **optimal properties and performance** through an adapted, economical and **environmentally friendly** manufacturing process.



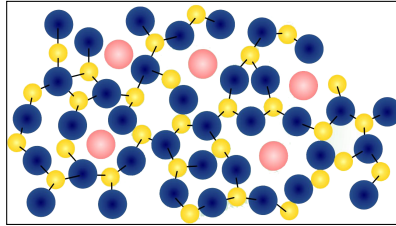
- **Sustainability, energy, materials for health...** The materials engineer is and will be at the heart of **innovations** in these fields.

- Materials are at the heart of technological revolutions
- Link between **microstructure** - **process** - **property** is key in all fields

Aluminium

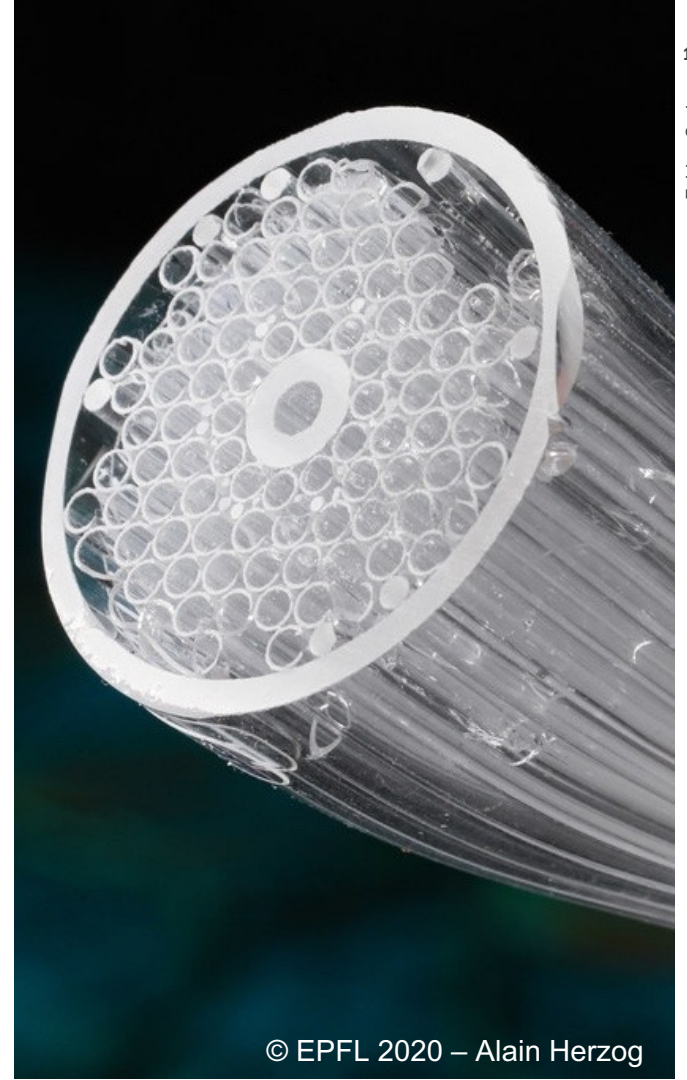


Silice



- Example:

- Optical fiber**



Materials Science & Engineering

An industrial, economical, ecological and societal impact

- **Transport:** composite materials, compared to metals, have saved 20% in terms of weight for airliners.
- **Infrastructure:** green cement and new materials can reduce CO₂ emissions by over 40%.
- **Energy:** semiconductor nanowires, batteries, nuclear energy... material and process innovations!
- **Health:** Novel immunotherapy approaches against cancer and nano-coatings against viruses.
- **Sport:** composite materials for novel ski technology.
- **Fundamental Science:** Computational materials science leads to novel understanding of materials and new materials for energy harvesting and storage.





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Why Materials Science and Engineering ?

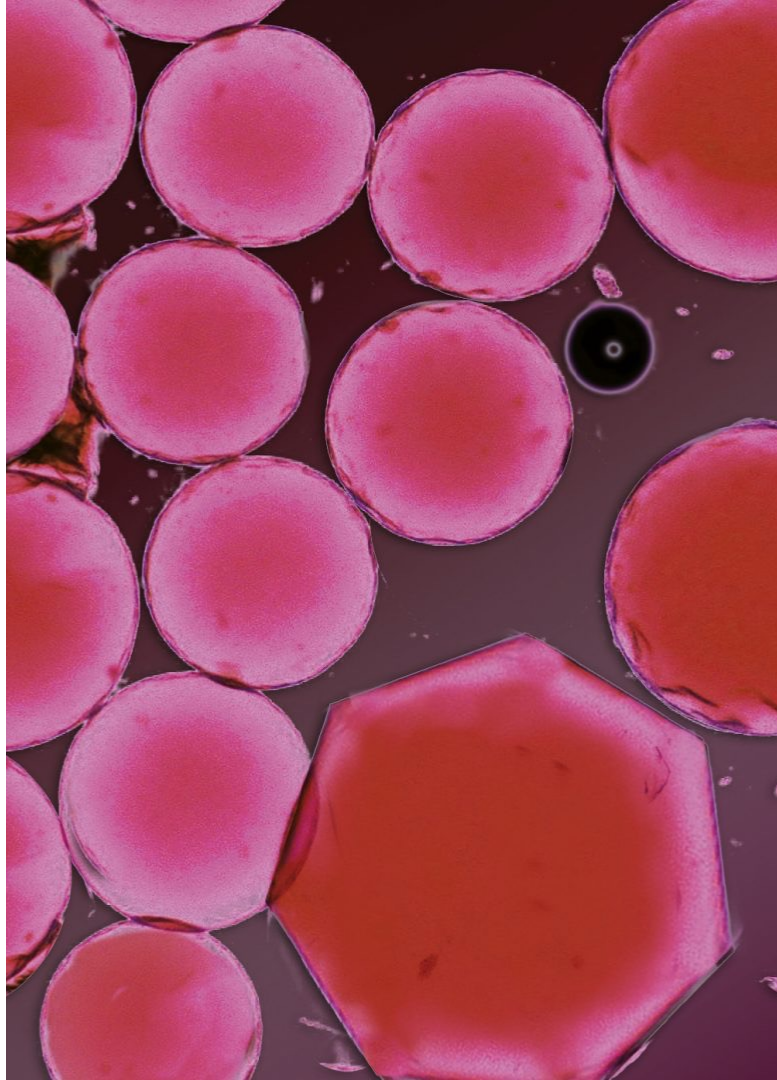
- Science and engineers at the heart of **tomorrow's technological solutions**: sustainability, climate, energy, health...
- Increasing demand for integration of new processes, consideration of life cycles, green extraction, recycling → **need for materials engineers in all industries**



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Why Materials Science and Engineering ?

- A **multidisciplinary and versatile** training:
 - at the interface between math, physics, chemistry and mechanics, with a wide range of specializations.
- The highway between **fundamental** and **applied**
- **Top international** training and research



Materials science

Materials science @EPFL

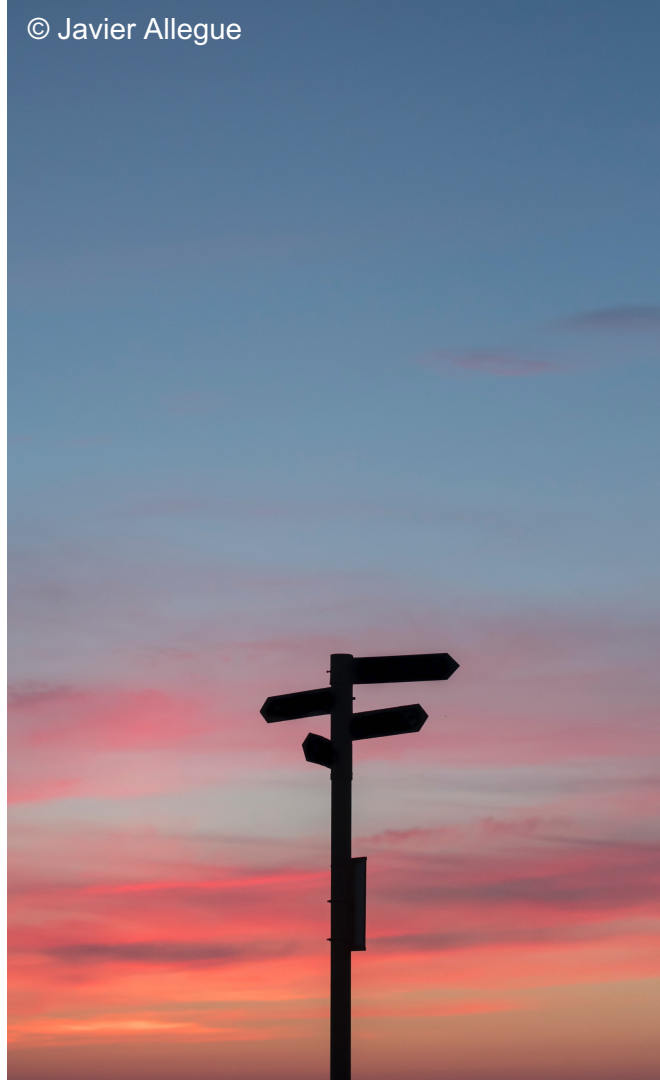
Master MX

- **EPFL Bachelor's degree in MSE**, or from another institution with an excellent academic record.
- A Bachelor's degree in **Physics, Chemistry, Mechanical Engineering, Life Sciences, Electrical Engineering, Microengineering**... with an excellent academic record can also be considered. However, candidates must demonstrate **skills in materials science**.
- [Further information about admission criteria](#)



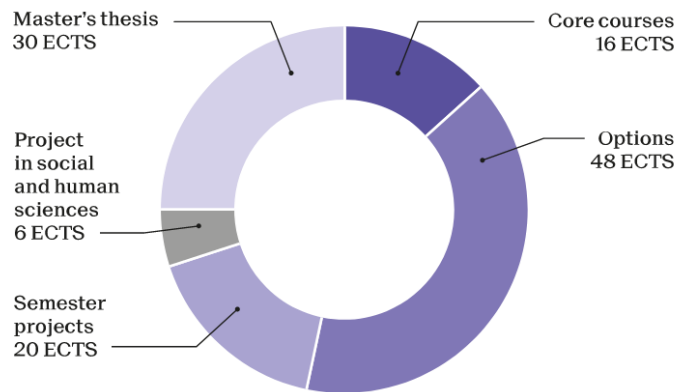
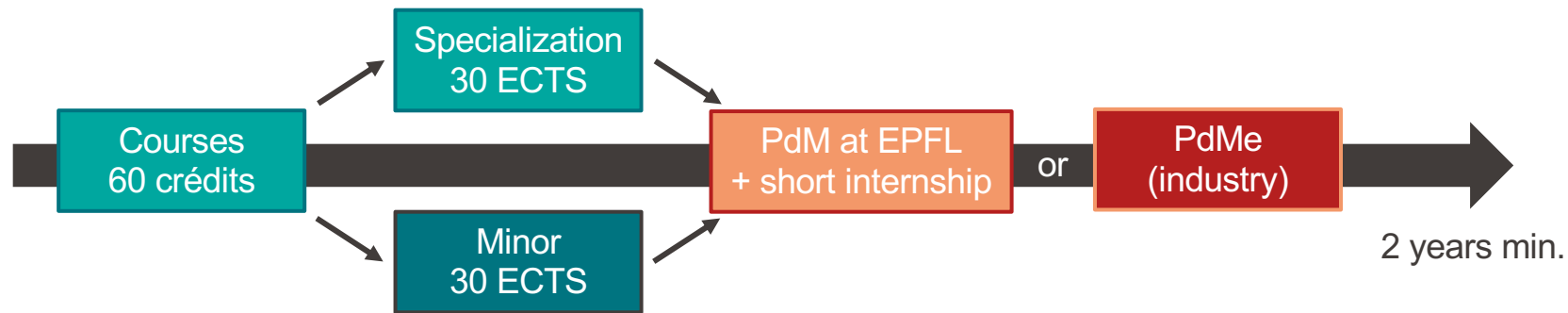
How to change section?

- To join a non-consecutive program between the Bachelor and the Master, students must **apply (during their last year of the Bachelor program) for admission** (2 deadlines per year: 15 Dec. and 15 Apr.) to the Master program of the section in which they wish to be registered.
- A **minimum average grade of 4.5** over the entire Bachelor's program is required. The quality of the application, the relevance of the followed Bachelor's program compared to the Master's cursus of interest, and the motivation of the candidate will also be assessed.
- The procedure and deadline for such an application can be found on the [EPFL Master promotion website](#).



Study plan – 120 ECTS

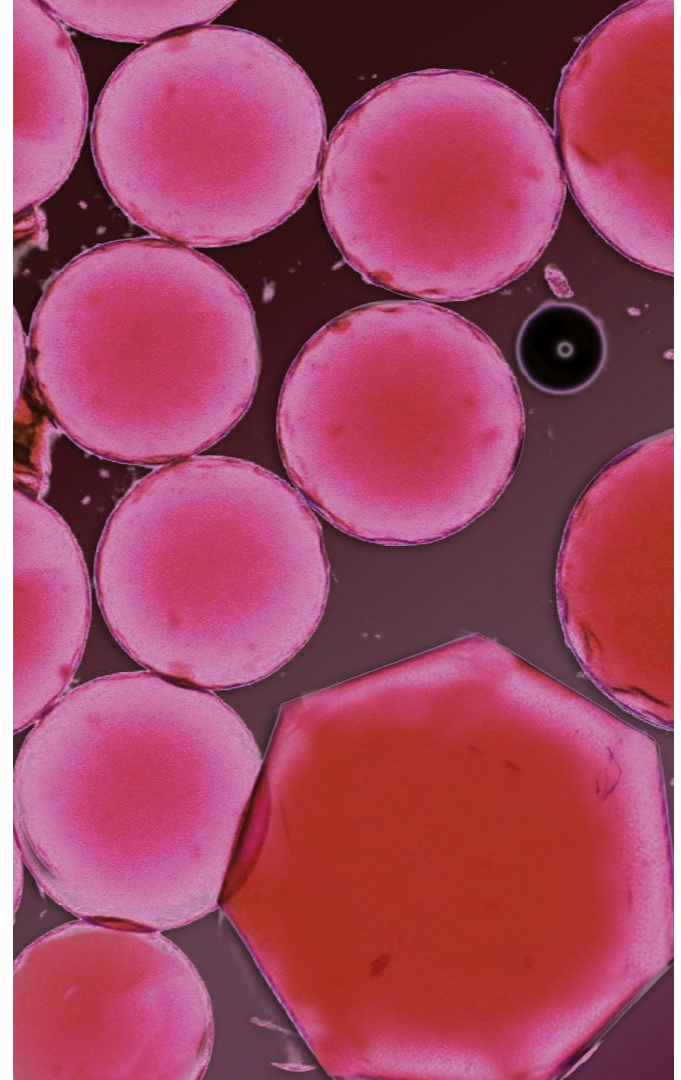
- A study plan that combines theory and practice



Core courses (16 ECTS)

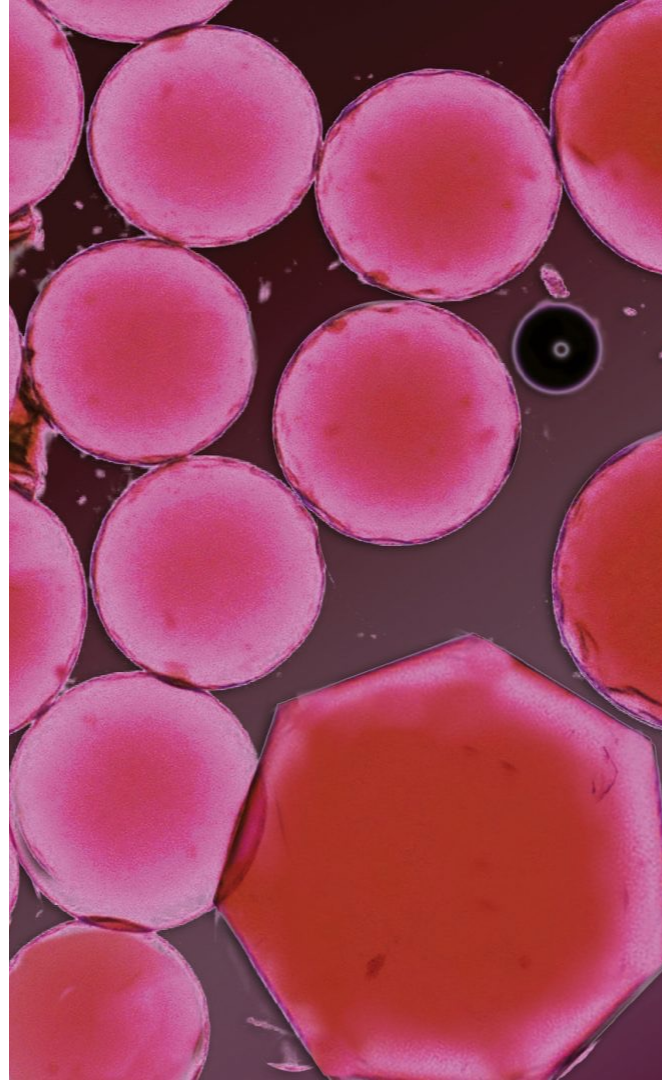
	Credits
Core courses in materials science	16
Advanced metallurgy	4
Fracture of materials	4
Fundamentals of solid-state materials	4
Soft matter	4
Statistical mechanics	4

- Two mandatory semester research projects



Options (48 ECTS)

Options	48
Assembly techniques	2
Atomistic and quantum simulations of materials	4
Biomaterials	4
Cementitious materials (advanced)	2
Composites technology	3
Electrochemistry for materials technology	2
Electron microscopy: advanced methods	3
Introduction to crystal growth by epitaxy	2
Introduction to magnetic materials in modern technologies	4
Life cycle engineering of polymers	2
Light, liquids and interfaces	4
Material science at large scale facilities	4
Materials selection	2
Mathematical methods for materials science	3
Nanomaterials	3
Organic electronic materials	4
Optical properties of materials	3
Physical chemistry of polymeric materials	3
Polymer chemistry and macromolecular engineering	3
Polymer morphological characterization techniques	2
Properties of semiconductors and related nanostructures	5
Recycling of materials	2
Research project in materials III	10
Seminar series on advances in materials	2
Surface analysis	3
Thin film fabrication technologies	2
Tribology	2
Wood structures, properties and uses	2



Specialization or minor (30 ECTS)

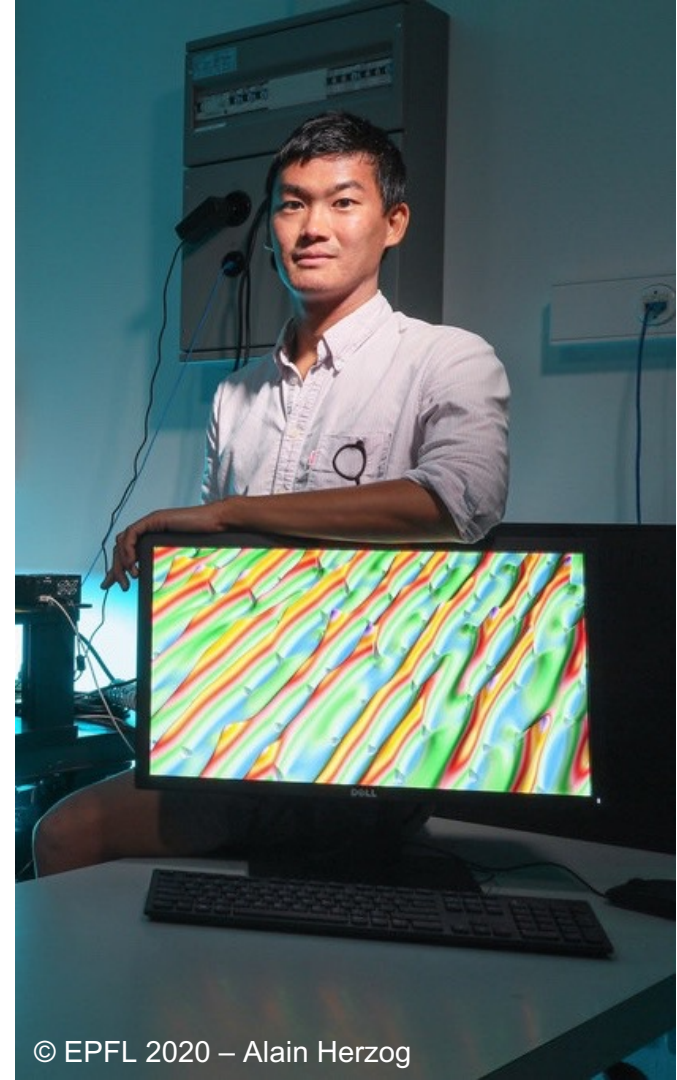
- Specialization:
A deepening in different areas of materials science, including the more fundamental aspect to pursue training through research.
- A versatile training :
 - Numerous opportunities for minors!



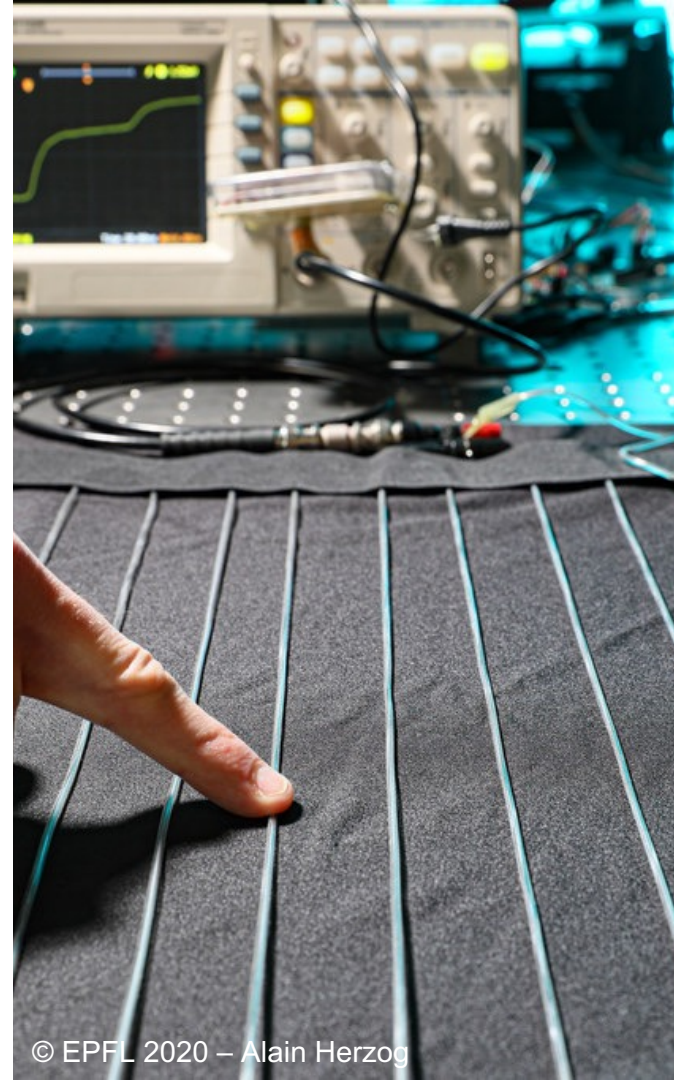
Specialization or minor (30 ECTS)

- Minors recommended:
 - **Chemistry and chemical engineering** (Chemistry and Chemical Engineering)
 - **Mechanical engineering** (Mechanical engineering)
 - **Engineering for sustainability** (Environmental Science and Engineering)
 - **Management of technology** (Management of technology)
 - **Science, technology and area studies** (College of Humanities)
 - **Energy** (Mechanical Engineering)
 - **Biomedical engineering** (Microengineering)
 - **Space technologies** (Electrical Engineering)
 - **Computational science and engineering** (Mathematics)

Other minors are possible: https://sac.epfl.ch/study_plans



- Mandatory internship **from 2 to 6 months** in industry in Switzerland or abroad
- Excellent opportunity for students to get a crucial insight into the day-to-day work-flow in industry and **provide the company with your broad expertise and skills** in materials science and engineering
- <https://www.epfl.ch/about/recruiting/recruiting/internships/>



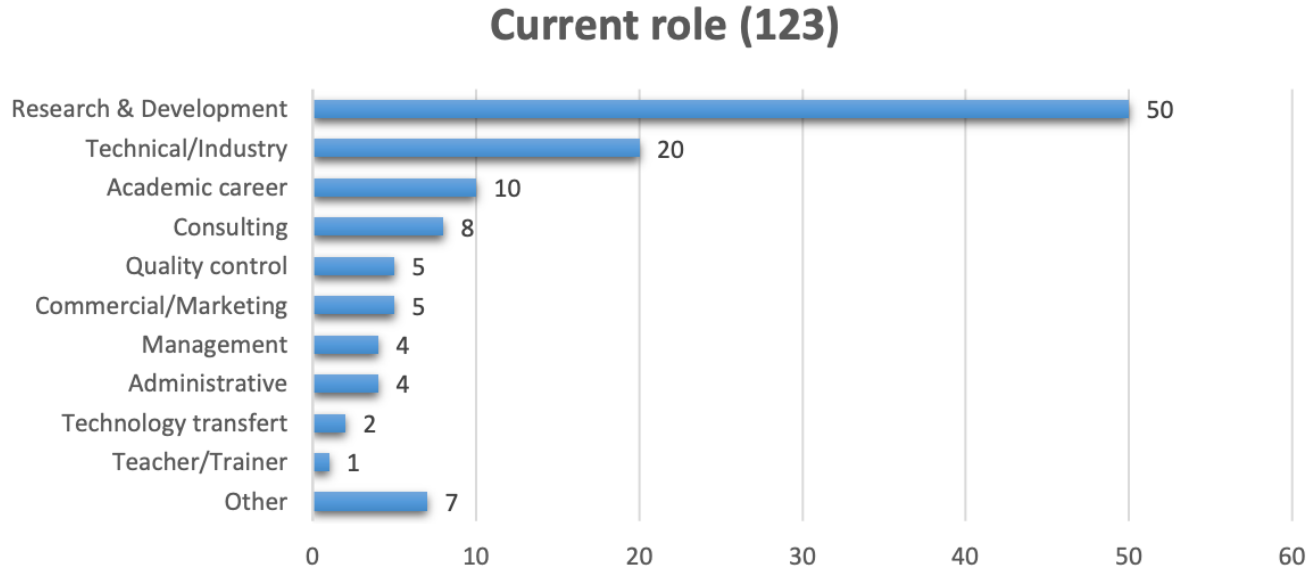
Master project

- **Academic** or **industrial** research project (17 or 25 weeks)
- Personal and original work covering theoretical and practical aspects of materials science using the knowledge acquired during his/her studies and enable him/her to develop **deeper knowledge, understanding, capabilities and attitudes** in the field of materials science.
- This project is made under the **supervision** of a professor of the SMX section

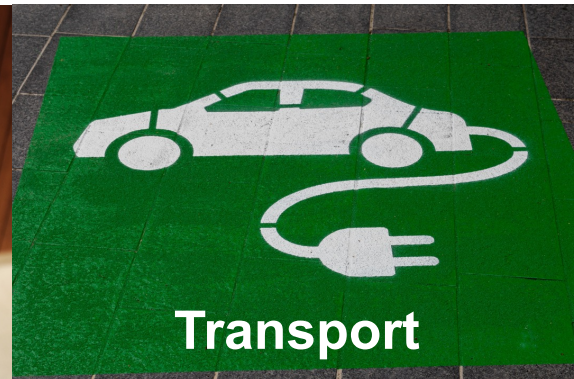
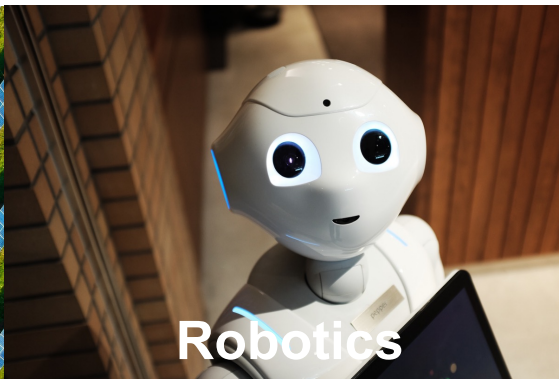
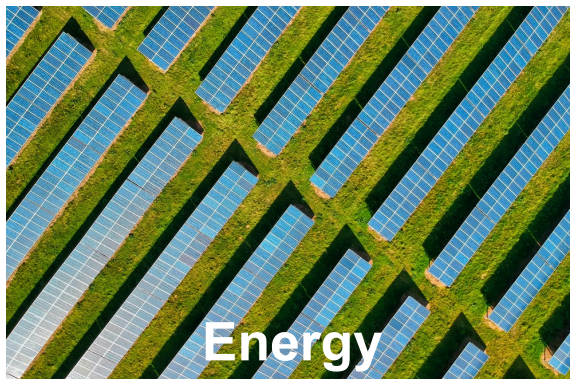


What future for our graduates?

- The vast majority are involved in **research and development, quality control, production, modeling...**
- **30%** of our Master's students go on to do a **PhD**
- More and more are joining **start-ups**... or creating them!

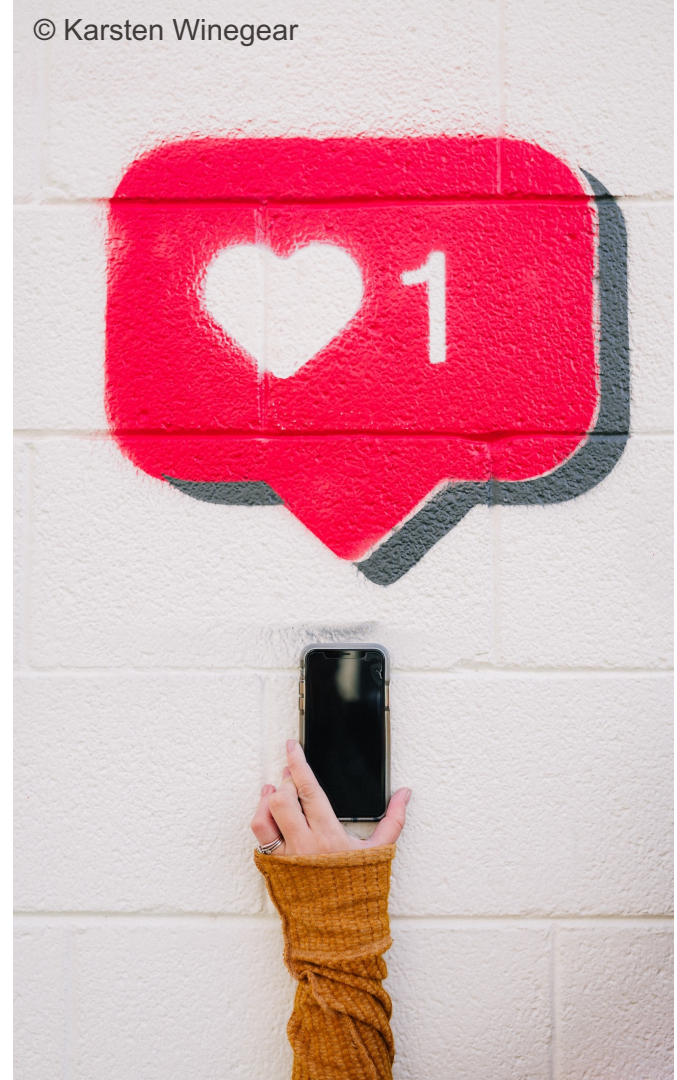


A wide range of applications



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- Testimonies:





Thanks!

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