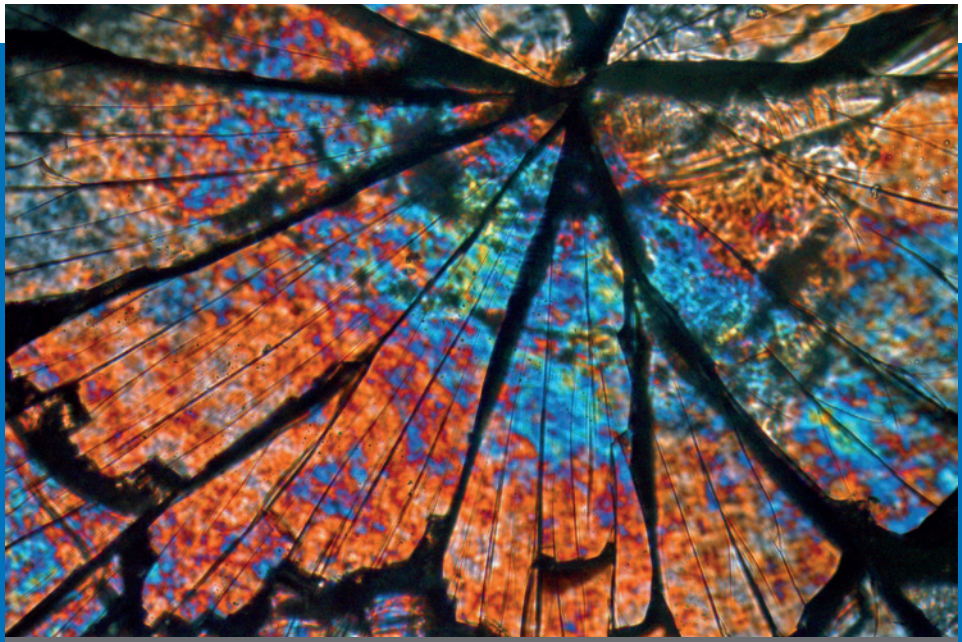
ETH zürich



MATERIALS SCIENCE

Master's Degree Program

D MATL.

Content

Cover picture: Liquid crystalline iron triazole complex (optical micrograph, crossed polarizers). (Polymer Technology).

Master's Degree Program in Materials Science at ETH Zurich

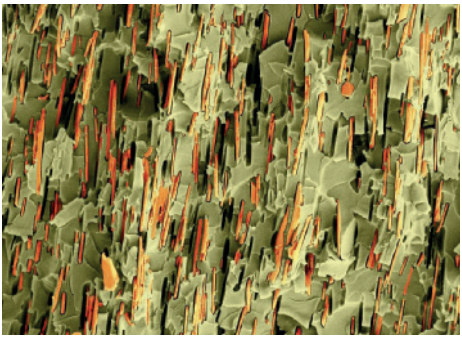
ETH Zurich is one of the leading international universities for technology and the natural sciences.

It is well-known for its excellent education, ground-breaking fundamental research and for putting its new findings directly into practice. It offers researchers an inspiring working environment and its students a comprehensive education.

ETH Zurich regularly appears at the top of international rankings as one of the best universities in the world. 21 Nobel Laureates have studied, taught or conducted research at ETH Zurich, underlining the excellent reputation of the institute.

The objectives of the Department of Materials at ETH Zurich are to conduct world-class materials research and to produce materials scientists and engineers who are educated at the highest level. In both research and education, the department is committed to the idea of materials science spanning many orders of magnitude in size scale, from atoms to products, and also stretching from highly fundamental studies to those with direct technological implications.

The Department of Materials counts 350 members with more than 80 nationalities being represented. All members are divided into the 16 research groups listed



Alignment of ultra-high magnetic responsive (UHMR) alumina platelets in an epoxy matrix (Complex Materials).

on page 16. Representatives of many different cultures work next to each other on a day to day basis, enhancing not only the quality of the scientific work but also enrichening all individuals. English is the main spoken language.

The Department of Materials offers one Bachelor's degree course as well as one Master's degree course. Currently, there are about 200 students enrolled in the Bachelor's and 100 students enrolled in the Master's degree course. Master students not only attend courses but are also integrated into research groups by working on two eight-week Master's projects as well as a six-month Master's thesis. This grants insight into various research groups and therefore topics and training in diverse scientific fields. According to project availability Master students can choose a research group of their wish to complete the projects in. A welcome side-effect of laboratory work is the social interaction crossing the boundary of the Master's degree courses.

In order to complete the Materials Science Master's degree course 120 credit points (CP) need to be achieved. Those 120 CP are obtained in the core, elective and GESS course category as well as by doing two Master's projects and a Master's thesis. The Master's degree program structure is presented in more detail in the next section.

Course Structure

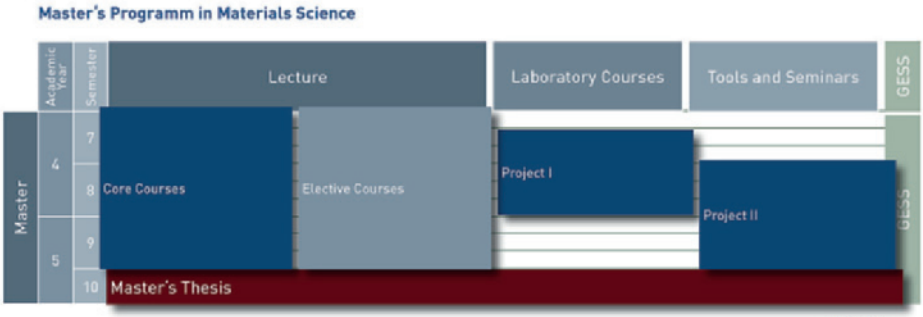
The Master's degree course in Materials at ETH Zurich is designed to be a two year, full-time study program.

During the Master's degree program 120 Credit Points (CP) are earned in the four different categories that are listed below. Master's degree graduates are awarded the title Master of Science ETH in Materials. The maximum study duration for the Master's degree course is 8 semesters.

1. Core courses (30 CP)

At least 30 CP need to be earned in the core course category. The entirety of all offered classes amounts to a maximum of 46 CP. Core courses are courses dedicated to overarching themes in the field of materials science. They form the basis of the Master's degree program since they provide students with core knowledge in problem-oriented perspectives.

All core courses are organized by the Department of Materials but guest lectures e.g. from industry may be an integral part of the classes. Core courses are divided into two parts: part I and part II. Part one is generally held in the fall semester, part II in the subsequent spring semester. It is recommended to attend part one of a core course before enrolling in part II, but there is no obligation to do so. All core courses are taught in English, take place on the Hönggerberg campus and are completed with a written examination at the end of the semester. If failed, core course



examinations can be repeated once. A short description of the lectures and the corresponding credit points is given on page 6 along with the day and time the classes are held.

2. Elective courses (30 CP)
Additional 30 or more CP are earned in the elective course category. These courses should deepen the student-specific knowledge in scientific and technical regard as well as broaden the student's subject-related background. All Master's degree level courses at ETH are allowed as electives. A list of recommended elective courses is given on page 10. Note that the recommended courses are not mandatory in any respect. Students are encouraged to individually create a curriculum tailored to their needs and interests.
It is highly recommended that students take enough time to choose their elective courses because the variety of course options and the schedules that can be put together are enormous.

3. D-GESS courses (6 CP)
On the Master's degree level too, students are encouraged to benefit from the general educational course offering by the GESS-Department. The students are thereby enabled to gain profound basic knowledge in various different domains other than their specialist discipline. The range of classes is extraordinarily large, from political science to philosophy through to business administration.
www.gess.ethz.ch →

4. Master's projects and Master's thesis
This last category serves to put the gained knowledge directly into context by performing original experiments. In principle, it is not allowed to carry out a Master's project or the Master's thesis in a company.

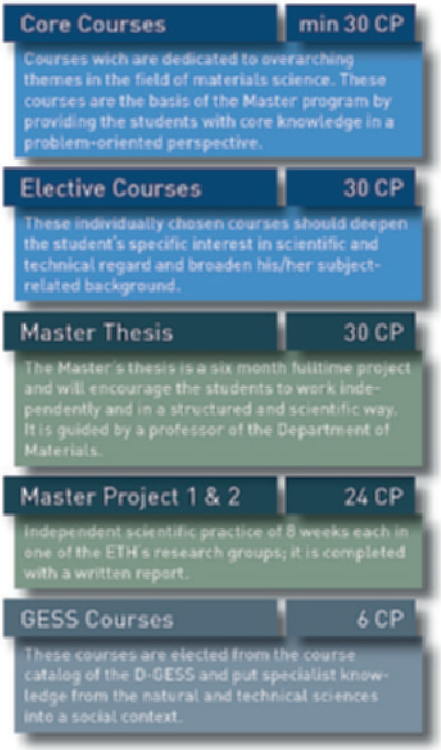
Master's project 1 and 2 (12 CP each): A Master's project is an 8-week project to practice individual scientific activity. The students support the research work of a

Category	Units	Credits
Subject-related courses (60 CP*)	Core courses	min 30 CP
	Elective courses	ca 30 CP
Research-related (54 CP)	Master Thesis	30 CP
	Master Project 1	12 CP
	Master Project 2	12 CP
General-education (6 CP)	GESS** courses	6 CP

*CP = credit points
** GESS = mandatory courses in humanities, social & political science

research group at ETH Zurich, thereby enhancing their laboratory skills and deepening subject-specific knowledge, but also contributing actively to state-of-the-art research. If fewer than 5 days per week are dedicated to the Master's projects (e.g. due to lectures) the duration of the Master's projects is extended in a way that the total working time amounts to eight weeks. Master's projects are not graded.

Master's thesis (30 CP): The Master's thesis concludes the Master's degree program. It constitutes a six-month, full-time project aimed at advancing the skills and capabilities of students to work independently and creatively toward the solution of a research problem under the supervision of a professor. The Master's thesis generally takes place during the entire 4th semester of the Master's degree program and is conducted in a D-MATL research group. In the past, the academic quality of those projects has shown to be outstanding.



Core Courses

At least 30 CP need to be obtained out of the following core courses.

327-0505-00L - **Surfaces, Interfaces & their Applications I** (3CP)
N. Spencer, M. P. Heuberger
Autumn semester, Mon 09-12
After being introduced to the physical/chemical principles and importance of surfaces and interfaces, the student is introduced to the most important techniques that can be used to characterize surfaces. Later, functionalization of surfaces is treated, followed by an introduction to the fields of tribology (friction, lubrication, and wear) and corrosion.

327-2205-00L - **Surfaces, Interfaces & their Applications II** (3CP)
P. Schmutz
Spring semester, Wed 09-12
This part of the course will be an introduction in the fundamental aspects of surface degradation mechanisms induced by (electro)chemical and mechanical interactions. Surface physico-chemical processes on metals/alloys exposed to liquids will be introduced and the different electrochemical methods necessary for the characterization of the solid-liquid interface will be presented.

327-1206-00L – **Soft Materials I** (4CP)
A.D. Schlüter, J. Vermant
Spring semester, Fri 10-12, 14-16
Part 1 of the course (spring semester) focuses on the chemistry of the building blocks and to learn how structures can be manipulated by chemistry, composition and phase behaviour. The goal is to learn what can be done, both in an idealized research environment and in the realm of industrial scale production.

327-1207-00L – **Soft Materials II** (4CP)
J. Vermant, L. Isa
Autumn semester, Tue+Fri 10-12
In the second part of the course we will introduce the experimental tools to study the materials at the invariably wide range of length scales, which are embedded in the microstructures that generate the desired properties.

327-1201-00L - **Transport Phenomena I** (4CP)
H.C. Öttinger
Autumn semester, Mon 13-17
In this course we study the phenomenological approach to "Transport Phenomena" based on balance equations supplemented by thermodynamic considerations to formulate the undetermined fluxes in the local species mass, momentum, and energy balance equations; fundamentals, applications, and simulations.

327-2201-00L - **Transport Phenomena II** (4CP)
H.C. Öttinger
Spring semester, Mo 13-17
In this course we study the numerical methods for real-world "Transport Phenomena"; atomistic understanding of transport properties based on kinetic theory and mesoscopic models; fundamentals, applications, and simulation.

327-1203-00L - **Complex Materials I: Synthesis & Assembly** (4CP)
M. Niederberger, D. Koziej
Autumn semester, Tue 15-17, Thu 09-11
This course is an introduction to materials synthesis concepts based on the assembly of differently shaped objects of varying chemical nature and length scales.

327-2203-00L - **Complex Materials II: Structure & Properties** (4CP)
J.F. Löffler, M. Fiebig
Spring semester, Mon 09-13
The course presents structure-property relationships in complex materials, such as photonic, phononic or ferroic crystals, heterostructures, and disordered materials.

327-1004-00L - **Materials at Work I** (4CP)
R. Spolenak, R. Koopmans, E. Dufresne
Autumn semester, Thu 11-15
The course "Materials at Work" focuses on the challenges of a materials engineer in the industrial environment. This ranges from materials selection over the environmental and political impact of materials to the specifics of the main materials classes: polymers, metals and ceramics in processing and application.

327-2204-00L - **Materials at Work II** (4CP)
R. Spolenak, D. Hegemann, A.R. Studart
Spring semester, Thu 13-17
Continuation of Materials at Work I

327-1202-00L – **Solid State Physics & Chemistry of Materials I** (4CP)
N. Spaldin
Autumn semester, Wed 09-13
In this course we study how the properties of solids are determined from the chemistry and arrangement of the constituent atoms, with a focus on materials that are not well described by conventional band theories because their behavior is governed by strong quantum-mechanical interactions.

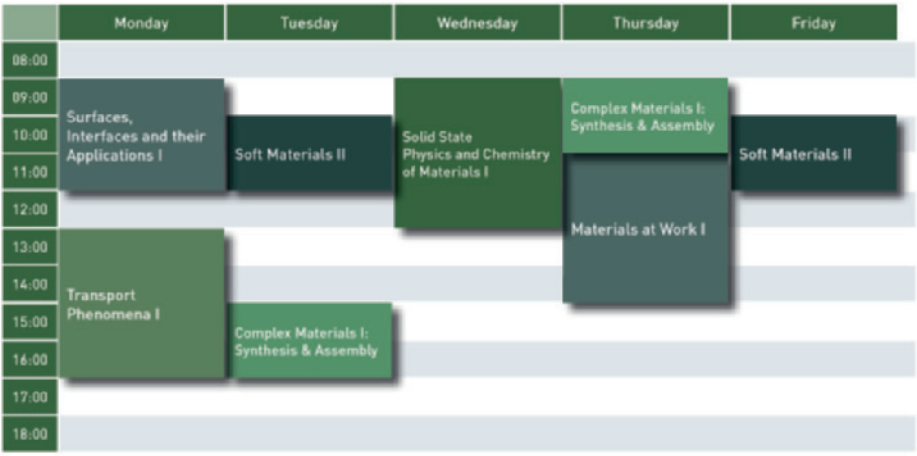
327-2207-00L – **Solid State Physics & Chemistry of Materials II** (4CP)*
N. Spaldin
Spring semester, Wed 13-17
Continuation of Solid State Physics and Chemistry of Materials I

327-2202-00L - **Size Effects in Materials** (4CP)*
R. Spolenak
Spring semester, Tue+Thu 09-11
The core of this course explains how the behavior of materials changes, when their external dimensions become small (usually on the micro- to nanometer length scale) until quantum effects become dominant. This is illustrated by examples from all materials classes and further substantiated by case studies of applications ranging from micro- and nanoelectronics to optoelectronics.

* "Solid State Physics & Chemistry of Materials II" and "Size Effects in Materials" are both designed as a second part of "Solid State Physics & Chemistry of Materials I". If both are passed, only one could be counted as a core course, the other one as elective course.

ETH *zürich*

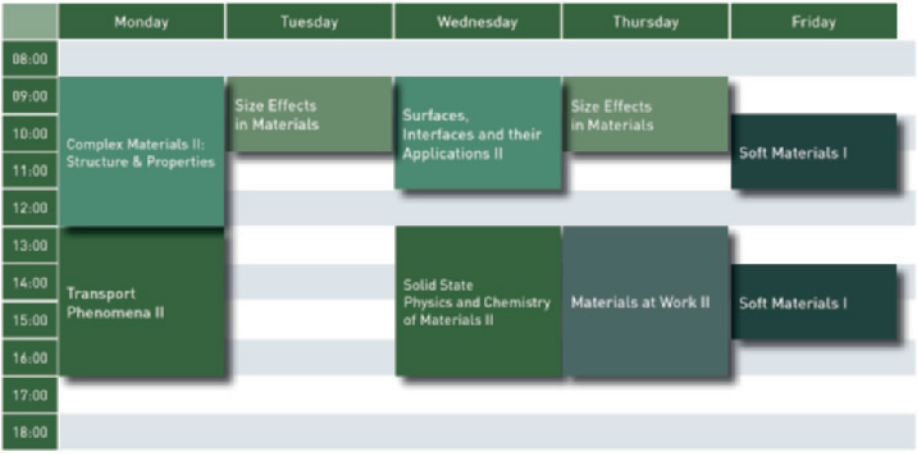
Material Science Master, Core Courses, Autumn Semester



D MATL. DEPARTMENT OF MATERIALS

ETH *zürich*

Material Science Master, Core Courses, Spring Semester



D MATL. DEPARTMENT OF MATERIALS

Elective Courses

The following table lists the recommended elective courses. However, the 30 CP can also be obtained from all of the other courses offered in one of the Master's degree programs of ETH Zürich.

Autumn Semester

327-2103-00L	Advanced Composite and Adaptive Material Systems	4 CP	G. P. Terrasi, F. J. Clemens
327-4101-00L	Durability of Engineering Materials	2 CP	J. Wheeler
327-0702-00L	EM-Practical Course in Materials Science	2 CP	K. Kunze, F. Gramm, F. Krumeich, J. Reuteler
327-0703-00L	Electron Microscopy in Material Science	4 CP	K. Kunze, R. Erni, S. Gerstl, F. Gramm, F. Krumeich,
327-2105-00L	Supramolecular Aspects of Polymers	2 CP	P. J. Walde
151-0605-00L	Nanosystems	4 CP	A. Stemmer, J. N. Tisserant
402-0313-00L	Materials Research Using Synchrotron Radiation	6 CP	L. Heyderman, V. Scagnoli
402-0809-00L	Introduction to Computational Physics	8 CP	H. J. Herrmann
529-0947-00L	Basic Polymer Synthesis	6 CP	A. D. Schlüter
752-2314-00L	Physics of Food Colloids	3 CP	P. A. Fischer, R. Mezzenga
327-1220-00L	Crystal Optics with Intense Light Sources	4 CP	M. Fiebig
327-0811-00L	Industrial Research and Development at the Interface of Biomaterials and Drug Delivery	1 CP	L. B. Uebersax, J. Goldhahn, F. Schlottig, R. Streicher
327-2125-00	Microscopy Training SEM I - Introduction to SEM	2 CP	S. Rodighiero, K. Kunze, J. Reuteler, A.G. Bittermann
327-2126-00	Microscopy Training TEM I - Introduction to TEM	2 CP	S. Rodighiero, F. Gramm, E. Barthazy Meier, A.G. Bittermann

Spring Semester

327-2221-00L	Advanced Surface Characterisation Techniques	4 CP	A. Rossi Elsener-Rossi
327-2222-00L	Soft Materials: from Fundamentals to Applications	3 CP	L. Isa
327-0613-00L	Computer Applications: Finite Elements in Solids and Structures	4 CP	A. Gusev
327-2104-00L	Inorganic Thin Films: Processing, Properties and Applications	2 CP	T. Lippert, C. Schneider
327-4105-00L	Integrity of Materials and Structures	4 CP	M. Roth, M. Barbezat, T. Graule
327-5102-00L	Molecular and Materials Modelling	4 CP	J. VandeVondele, D. Passerone
151-0060-00L	Thermodynamics and Energy Conversion in Micro- and Nanoscale Technologies	4 CP	D. Poulikakos, H. Eghlidi, T. Schutzius
151-0622-00L	Measuring on the Nanometer Scale	2 CP	A. Stemmer
376-1614-00L	Principles in Tissue Engineering	3 CP	K. Maniura, J. Möller
402-0468-15L	Nanomaterials for Photonics	6 CP	R. Grange
402-0558-00L	Crystal Optics in Intense Light Fields	6 CP	M. Fiebig
327-2223-00L	Atomic Force Microscopy in Materials Science	4 CP	N. Burnham, N. Spencer
327-2224-00L	MaP Distinguished Lecture Series on Additive Manufacturing	1 CP	A. R. Studart, M. Meboldt
327-1220-00L	Multifunctional Ferroic Materials	4 CP	M. Fiebig
860-0015-00L	Supply and Responsible Use of Mineral Resources I	3 CP	C. A. Heinrich, L. Bretschger, F. Brugger, S. Hellweg, B. Wehrli

Student Exchange (Mobility)

In the Materials Master's degree program a maximum of 40 CP can be earned at a university other than ETH Zurich.

The credit points earned can originate from the elective and/or GESS course categories or be obtained by Master's project(s) or thesis. Core courses must be completed at D-MATL at ETH Zurich and can not be replaced by any similar class at a different university.

Elective courses and/ or D-GESS courses
Students wishing to spend some time abroad may acquire the full 30 CP from the elective course category at a different university of their choice. All D-GESS course requirements can be fulfilled abroad too, as long as the chosen classes are comparable to the D-GESS course catalogue at ETH Zurich.
The curriculum wished to be fulfilled abroad must be discussed with the director of studies at the Department of Materials, Prof. Dr. Nicola Spaldin.

Master's projects 1 & 2
Master's projects can be completed in any research group at ETH Zurich or abroad. All CP earned by projects carried out at ETH Zurich in a department other than D-MATL are not counted towards the 40 CP obtainable in student exchange.

Master's thesis (30 CP)
Master's theses may be conducted abroad. Doing so will only be permitted after a qualified D-MATL professor agrees to take on the thesis' technical responsibility. This means that a D-MATL professor must assess the thesis' quality and confirm that it meets ETH Zurich standards. He/she also has to agree upon the thesis' recommended grade, given by the supervisor abroad.

More information
For all detailed requests please contact the head of the mobility program at the Department of Materials, Prof. Dr. Peter Walde (peter.walde@mat.ethz.ch).

Application to the Master's degree program in Materials

General information

There are two application periods:
1) November 1st – December 15th
2) March 1st – March 30th

Students applying for the Materials Science Master's degree program may be asked to fulfill additional requirements to be admitted to the program, depending on the scope of their previous education. Those additional requirements usually are Materials Science Bachelor's degree courses. In some cases the additionally required classes are taught in German. In those cases the students must prepare for the exams in self-study. The time span to fulfill imposed conditions is 18 months at the very maximum, possible exam repetitions included. If, after 18 months the conditions have not been met, the student will be dematriculated automatically and inevitably.

The Rectorate processes all applications. The application form and detailed information about the application can be found on the web.
www.admission.ethz.ch/master →

A non-refundable handling fee is payable with the application. There is no fee for candidates from ETH Zurich, EPF Lausanne and holders of an IDEA League Scholarship.

What you also need to know ...

Academic calendar
The academic year at ETH Zurich is divided into two semesters of 14 weeks each. The Autumn Semester runs from mid-September to the end of December (calendar weeks 38 to 51) and the Spring Semester lasts from mid-February to the end of May (weeks 8 to 22). Examinations usually take place at the end of each semester and towards the end of each semester break. Semester and examination dates can be found online at:
www.rektorat.ethz.ch/calendar/index_EN →

Course Catalogue
The Course Catalogue (VVZ) for each new semester is generally published in calendar week 20 (for autumn semester) and in calendar week 46 (for spring semester). The information published in the Course Catalogue is binding once the semester has started.
www.vvz.ethz.ch →

MyStudies
MyStudies is the student's web application. It is the central application for all students to administrate their studies. Among the most important activities in myStudies are: enrollment for the new semester, registration for courses and examinations, transcript of records, and diploma request.
Throughout the semester, most of the administrative tasks can be done quickly and reliably thanks to online access:
www.mystudies.ethz.ch →

Performance assessments
The examination mode of a course is published in the Course Catalogue of ETH Zurich. In general, most of the examinations are either end-of-semester exams or session examinations (carried out during the examination sessions, which are held twice per year).
www.ethz.ch/en/studies/legal-principles-degrees/performance-assessments/examination-types.html →

Tuition and semester fees, scholarships

The tuition fee at ETH Zurich is CHF 580 per semester. The tuition fee covers the enrolment in all courses. It is payable for each regular semester and for the semester in which the Master's thesis is written. Additionally a compulsory semester fee of CHF 64 must be paid by every student. It consists of CHF 25 for the Academic Sports Association Zurich (ASVZ), CHF 7 for the Scholarship fund and CHF 32 for the ETH Zurich Student Union (VSETH) for general services.

www.ethz.ch/en/studies/financial/tuition-fees.html →

ETH offers limited scholarships. It is primarily the responsibility of students and their families to finance their studies. ETH offers some scholarships for study and living costs and specific scholarships for excellent students on the Master's degree level.

www.ethz.ch/students/en/studies/financial/scholarships.html →

More Information & Contact

The International Student Support at ETH Zurich is your first address for any information about studying at ETH Zurich and living in Zurich.

www.ethz.ch/en/studies/international-immigration-housing.html →

The International Student Support issues a detailed handbook for international students:

www.ethz.ch/content/dam/ethz/main/education/internationales/pdf-en/handbook.pdf →

For all information concerning the study program in Materials please contact the **Student Office** of the Department of Materials directly.

www.mat.ethz.ch/studies/student-contacts.html →

studies@mat.ethz.ch

D-MATL Research Groups 2016

COMPLEX MATERIALS
Prof. André Studart

ELECTROCHEMICAL MATERIALS
Prof. Jennifer Rupp

INTERFACES, SOFT MATTER AND ASSEMBLY
Prof. Lucio Isa

MAGNETISM AND INTERFACE PHYSICS
Prof. Pietro Gambardella

MATERIALS THEORY
Prof. Nicola Spaldin

MESOSCOPIC SYSTEMS
Prof. Laura Heyderman

METAL PHYSICS AND TECHNOLOGY
Prof. Jörg F. Löffler

MULTIFUNCTIONAL FERROIC MATERIALS
Prof. Manfred Fiebig

MULTIFUNCTIONAL MATERIALS
Prof. Markus Niederberger

NANOMETALLURGY
Prof. Ralph Spolenak

NANOSCALE SIMULATIONS
Prof. Joost VandeVondele

POLYMER CHEMISTRY
Prof. A. Dieter Schlüter

POLYMER PHYSICS
Prof. Hans Christian Öttinger

SOFT AND LIVING MATERIALS
Prof. Eric Dufresne

SOFT MATERIALS
Prof. Jan Vermant

SURFACE SCIENCE AND TECHNOLOGY
Prof. Nicholas D. Spencer

Location of D-MATL

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Academic Affairs D-MATL
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www.mat.ethz.ch

Publisher	Department of Materials
Editor	Andrea Schrott
Layout	Sara Morgenthaler
Photos	I. Bräunlich, R. Libanori
Print	Staffeldruck