ACCESS TO EPFL

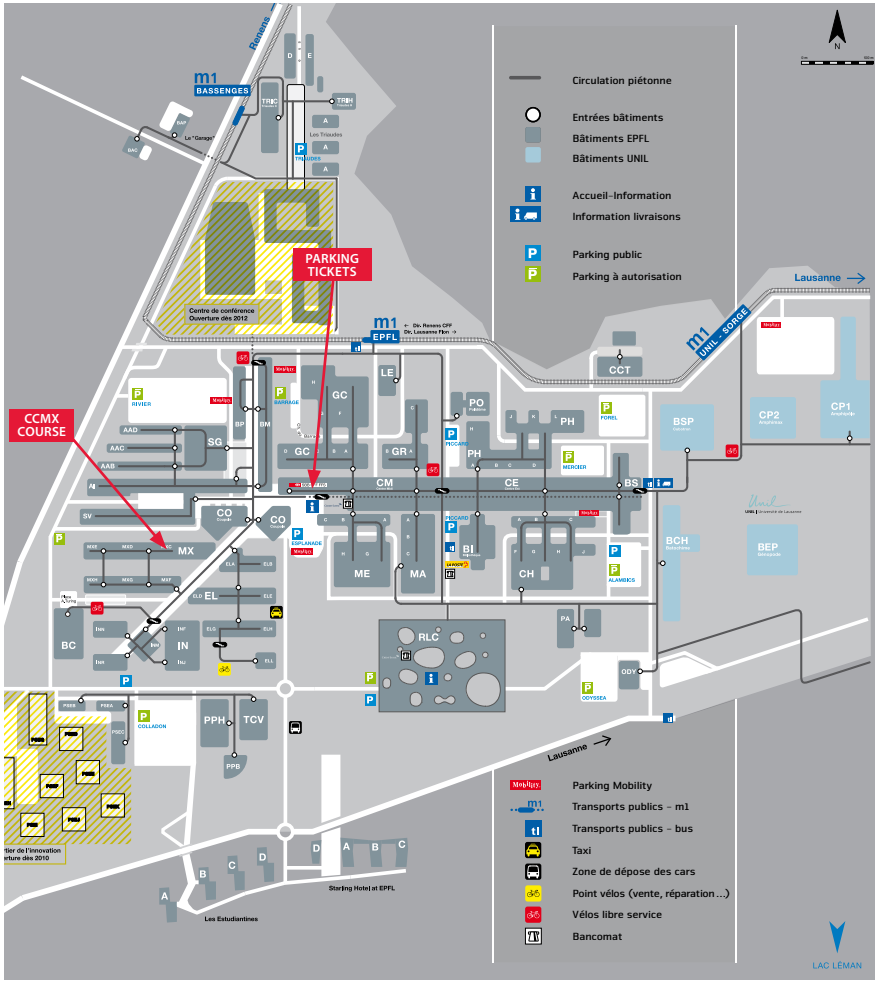
By the motorway

From Vevey or Genève, exit at Lausanne-Sud/EPFL. Parking is available on-site EPFL, one-day tickets (5 CHF) are available from the “Accueil-information” Office

By Metro m1

From Flon/Lausanne or the CFF train station in Renens, metro stop EPFL.

Signposting will be available on site.

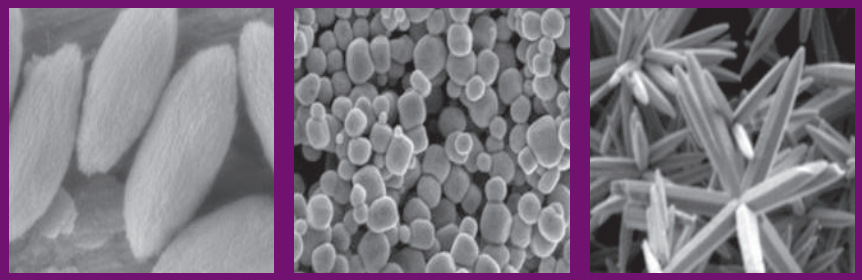


CCMX
Competence Centre for
Materials Science and Technology

CCMX ADVANCED COURSE

Inorganic Particle Synthesis by Precipitation:

From Nanoparticles to Self-organised Mesocrystals and from Theory to Practice



21–23 March 2016

EPFL, Lausanne

OBJECTIVES

- Introduction to the basics behind precipitation of inorganic powders in theory and in practice
- Discussion of the fundamental concepts of supersaturation, nucleation, growth and aggregation
- Brief introduction to some basic methods used for powder characterisation
- Demonstration of real sample characterisation and correct interpretation of the results collected
- Presentation of precipitation reactors from batch to continuous and in-situ monitoring
- Presentation of "sol-gel" routes in both aqueous and non-aqueous environments
- Thermodynamic and kinetic modelling towards understanding growth mechanisms

TOPICS

- Precipitation basics — supersaturation, nucleation, growth and aggregation
- Powder characterisation — particle size, surface area, morphology (microscopy), X-ray powder diffraction, zeta potential and thermogravimetric analysis
- Precipitation in practice — reactor engineering — from batch to continuous reactors
- "Sol-gel" routes in both aqueous and non-aqueous environments and polyol routes
- Modelling — solution thermodynamics, kinetics (population balance), aggregation, self-assembly
- Case studies — Superparamagnetic iron oxides, towards Good Manufacturing Practice (GMP) for biomedical applications

Please note that while the theory presented in this course applies to many types of materials, the practical examples concentrate on inorganic materials. Also due to limited time only a brief overview of the theory can be given although key references for more advanced analysis are provided throughout.

WHO SHOULD ATTEND?

Academic and industrial engineers, PhD students and researchers. The number of participants is limited to a maximum of 18 and the course is given in English.

LOCATION

EPFL, Lausanne – Room MXC320 (see map on page 8).

PARTICIPATION FEES

- 360 CHF for PhD students, CCMX industrial members and academic researchers from Swiss universities and research institutions
- 1'500 CHF for all other participants

Fee includes coffee, lunch and VAT
Travel and hotel should be reserved and paid for by the participants.

Details for cancellation conditions

www.ccmx.ch/courses-amp-events/conditions-for-participation/

CONTACT INFORMATION

Course topics

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Registration questions

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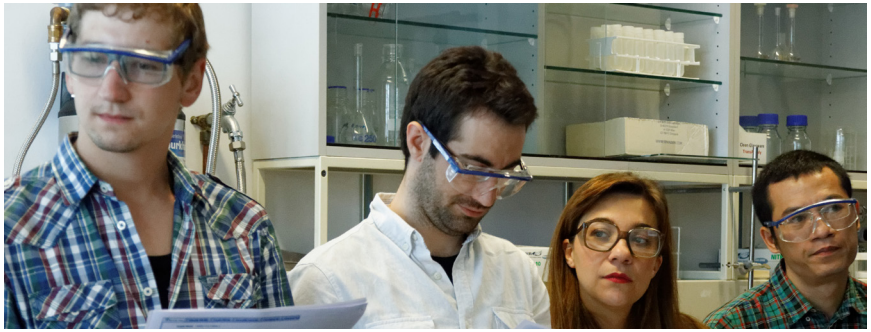
WEDNESDAY, 23 MARCH

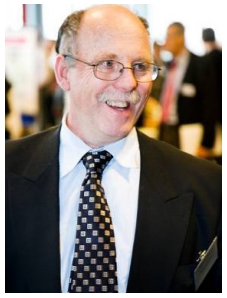
9:00	Modelling I (A. Testino) • Solution thermodynamics • Precipitation kinetics and population balance methods • Case studies — towards precipitation mechanisms
10:30	Coffee Break
11:00	Modelling II (A. Testino & P. Bowen) • Interparticle interactions — interparticle forces and potentials • Modelling of aggregation • Self-assembly — mesocrystals — shape control • Case studies - examples /visualisation/molecular dynamics
12:30	Lunch together
14:00	Examples and case studies - towards Good Manufacturing Practice (H. Hofmann) • Super paramagnetic iron oxides (SPIONS) for biomedical applications Discussion of course participants' specific concerns
15:30	Concluding remarks
15:45	End of course
16:00–17:00	Examination for doctoral school credits



LECTURERS

Prof. Paul Bowen obtained his PhD in Physical Chemistry in the field of catalysis from the University of Cambridge, UK, in 1982. He then worked at the BP Research Centre, Sunbury, UK, for four years in applied surface sciences before moving to Switzerland and EPFL in 1987. He has been at the Powder Technology Laboratory, in the Materials Institute since its conception in 1988. His main research interests are powder synthesis, powder characterisation, colloidal processing and sintering of ceramics, and atomistic modelling of surfaces and interfaces.

Prof. Markus Niederberger is Chair of the Laboratory for Multifunctional Materials at ETH Zurich. He studied chemistry at ETH Zurich, where he also received his PhD. After a postdoc at the University of California at Santa Barbara, he became group leader at the Max Planck Institute of Colloids and Interfaces in Potsdam. In 2007 he was appointed Assistant Professor in the Department of Materials at ETH Zurich and promoted to Associate Professor in 2012. His research focuses on the development of liquid-phase synthesis and assembly routes to inorganic functional materials over all length sclaes.



Prof. Heinrich Hofmann studied Material Science and Engineering at the Technical University of Berlin. He received his PhD in Material Science in 1983 at the Max Planck Institute and remained there as a senior scientist working on hard metals and composites until 1985, when he joined the R&D centre of Alusuisse-Lonza Services AG. There, he worked on the development of new titania stabilized zirconia and silicon nitride powders. In 1993, he joined EPFL as Professor and Director of the Powder Technology Laboratory.

Dr. Andrea Testino received his PhD in Material Science (2004) from the University of Genoa and did post-doctoral work at EPFL and at University College London before joining the University of Milan (Italy) as a permanent researcher working on nanoparticle synthesis and characterisation in 2005. In 2007 he joined TDK-EPC in Austria as Senior Development Engineer before moving to the Paul Scherrer Institut as Senior Scientist in 2011, establishing the Advanced Nanopowders Synthesis Laboratory. He is now focused on the continuous synthesis of nanoparticles and thermodynamic and kinetic modeling of precipitation processes.

MONDAY, 21 MARCH

9:00	Welcome + Introduction to the course
9:15	Precipitation Basics — growth and aggregation (P. Bowen) • Precipitation generalities • Supersaturation and nucleation • Particle growth — crystallisation
10:30	Coffee Break
11:00	Precipitation Basics (P. Bowen) • Particle growth — aggregation • Self-assembly — mesocrystals • Non-classical growth & pre-nucleation species
12:30	Lunch together
14:00	Powder Characterisation I (P. Bowen) • Particle size measurement • Surface area and porosity measurement — nitrogen adsorption/ desorption • Morphology (microscopy)
15:30	Coffee Break
16:00	Powder Characterisation II (P. Bowen) • X-ray powder diffraction • Zeta potential • Thermogravimetric analysis and examples
	Discussion on the topics of the day
17:30	End of first day

TUESDAY, 22 MARCH

9:00	Preciptiation in Practice — reactor engineering — from batch to continuous reactos (P. Bowen/H. Hofmann) • Batch reactor and mixing consideration • Continuous reactors • Practical case studies
10:30	Coffee Break
11:00	Practical demonstrations (P. Bowen) • Batch and continuous reactors, mixing • Surface area and porosity measurement – nitrogen adsorption/ desorption • Particle size measurement
12:30	Lunch together
14:00	"Sol-gel" routes in both aqueous and non-aqueous environments (M. Niederberger) • Aqueous routes • Non-aqueous routes • Polyol routes
15:30	Coffee Break
16:00	"Sol-gel" routes in both aqueous and non-aqueous environments (M. Niederberger) • In-situ monitoring — towards precipitation mechanisms • Examples, case studies
	Discussion on the topics of the day
17:30	End of second day