Stockholm University
Department of Chemistry

Electron Microscopy for Materials Characterization

1-30 September, 2025

KZ7016 7.5hp https://sisu.it.su.se/search/info/KZ7016/en

The course will start on September 1 (Monday) at 9:15. Lectures, problem solutions and practical training sessions are conducted 9:15-12:00 and 13:00-16:00 according to the detailed schedule below. Demonstrations, problem solutions, and practical training sessions are the *compulsory parts* of the course. Lectures and exercises will be given in C513, and the exam will be in C516. The students will be divided into groups for the practical sessions.

Teachers:
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Course Responsible:
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Literature:
RE: *Physical Principles of Electron Microscopy: An introduction to TEM, SEM and AEM*, R.F. Egerton, Springer
WC: *Transmission Electron Microscopy: A Textbook for Materials Science*, D.B.Williams and C.B.Carter, 2nd edition, 2009, Springer. https://libris.kb.se/bib/11775751 http://dx.doi.org/10.1007/978-3-319-26651-0
ZHO: *Electron Crystallography - Electron microscopy and electron diffraction*, X. Zou, S. Hovmöller, P. Oleynikov, Oxford University Press. https://libris.kb.se/bib/12544168
CW: *Transmission Electron Microscopy*, C.B. Carter, D.B. Williams, eds., Cham, 2016, Springer. https://libris.kb.se/bib/19667958
* Additional materials handed out at the lectures and practical sessions.
# The actual date of lab and exercise depends on the number of participants and will be finalized at the beginning of the course.

Week	Date	Teacher		Lecture (9:15 – 12:00)	Literature	Lab (13:00 -16:00) #
36	1/9 (Mon)	L1	XZ AA	General introduction to electron microscopy as tools for materials characterization Introduction to scanning electron microscopy (SEM)	RE: 5	
	2/9 (Tue)					
	3/9 (Wed)	L2	AA	Introduction to Energy Dispersive Spectroscopy (EDS) and Wave Dispersive Spectroscopy (WDS)	RE: 6	SEM lab (Group A) - EI EDS demo lab (Group B) - SB
	4/9 (Thurs)	L3	AA	Applications of analytical SEM techniques for materials characterization	*	SEM lab (Group B) - EI EDS demo lab (Group A) - SB
	5/9 (Fri)			SEM lab (Group C) - EI EDS demo lab (Group D) - SB		SEM lab (Group D) - EI EDS demo lab (Group C) - SB
37	8/9 (Mon)	L4	CWT	Introduction to transmission electron microscopy (TEM), electron-matter interactions	WC: 1-3	
	9/9 (Tue)	L5	CWT	Instrumentation and Electro-optics, aberration correction	WC: 5-10	Exercise 1 (All) – EI

	10/9 (Wed)	L6	CWT	TEM sample preparation (powder, FIB, ion milling, ultramicrotome, cryo-transfer)	WC: 10	Introduction of TEM & sample preparation (Group A+B+C+D) - EI
	11/9 (Thurs)	L7	XZ	Electron diffraction (ED) and phase analysis	WC: 11-13, 18; ZHO: 5	TEM + ED lab (Group A) - SB
	12/9 (Fri)			TEM + ED lab (Group B) - SB		TEM + ED lab (Group C) - SB
38	15/9 (Mon)					TEM + ED lab (Group D) - SB
	16/9 (Tue)	L8	XZ	Imaging: BF, DF and phase contrast	WC: 22-23	Exercise 2 (All) – SB & EI
	17/9 (Wed)	L9	XZ	Contrast transfer function (CTF) and high-resolution transmission electron microscopy (HRTEM)	ZHO: 6 WC: 28, 30	HRTEM lab (Group A) - EI
	18/9 (Thu)			HRTEM lab (Group B) - EI		HRTEM lab (Group C) - EI
	19/9 (Fri)	L10	CWT	Scanning transmission electron microscopy (STEM) techniques: BF, ADF, HAADF, iDPC	CW 11*	HRTEM lab (Group D) - EI
39	22/9 (Mon)	L11	CWT	TEM/STEM Spectroscopy (EDS and Electron energy loss spectroscopy (EELS)	WC 4, 37-40*	STEM+EELS lab (Group A) - AA
	23/9 (Tue)			STEM+EELS lab (Group B) - AA		STEM+EELS lab (Group C) - AA
	24/9 (Wed)	L12	CWT	In situ TEM characterization techniques, Applications of analytical EM in sustainable materials chemistry	CW: 2	STEM+EELS lab (Group D) - AA
	25/9 (Thurs)					
	26/9 (Fri)	L13	ALL	Repetition: questions and answers		
40	29/9 (Mon)					
	30/9 (Tue)	**Examination (9:15-14:00) – C516**				