UNIVERSITA' DEGLI STUDI DI CATANIA

DOTTORATO DI RICERCA IN SCIENZA DEI MATERIALI E NANOTECNOLOGIE

COURSE DESCRIPTION

Name	Transmission Electron Microscopy and related methodologies
Teacher(s)	M. Chiara Spadaro, Antonio M. Mio, Jordi Arbiol
Email	Mariachiara.spadaro@unict.it, antonio.mio@cnr.it, jordi.arbiol@icn2.cat
CFU* (lecture+lab [h])	3 (18 + 0)
Assessment **	Slide presentation

* 1 CFU = 6 h lectures OR 12 h in lab OR a combination (3h lectures+6h lab, or 4+4, or 2+8, …)

** it must be within the course duration. Please, indicate: written, oral, by slide presentation.

PROGRAM

The electron microscope (Basic design of the electron microscope / Electron sources / Magnetic lenses (properties and their aberrations) / Illumination of the specimen: transmission and/or scanning electron microscopy / Sample thinning techniques: mechanical polishing, ion milling, focused ion beam)

Electron diffraction (Scattering of electrons from atoms and perfect crystals: the reciprocal lattice, reflecting sphere construction, Laue zones, effects due to structure factor, diffraction from various crystal shapes)

Kinematical theory of image contrast (Dark–field and bright–field imaging)

Electron energy loss spectroscopy and energy filtered imaging (The electron energy loss spectrum / Energy–analyzing instrumentations / Excitation of Outer–Shell Electrons / Volume plasmons / Inner–Shell excitations)

Scanning transmission electron microscopy (Probe formation and aberration / Bright–field and annular dark–field imaging / Coherent and incoherent imaging / Z–contrast / Atomic resolved X–ray energy dispersion and/or electron energy loss spectroscopy / differential phase contrast /applications)

Modelling and image simulation (image interpretation, linear STEM approximation, Multislice, applications)

In situ and operando microscopy and spectroscopy (experiments in real conditions: biasing, in gas environment, in liquid / applications)

TEM automation (data acquisition and analysis)

REFERENCES

- D.B. Williams, C. B. Carter, Transmission Electron Microscopy, A Textbook for Materials Science, Springer (2009)
- J. M. Zuo, J. C. H. Spence, Advanced Transmission Electron Microscopy, Springer-Verlag, New York (2017)
- R.F. Egerton, Electron Energy-Loss Spectroscopy in the Electron Microscope, 2nd edn. Springe r, New York (2011)
- P.W. Hawkes, J.C.H. Spence (Eds.), Springer Handbook of Microscopy, Springer Handbooks (2019) https://link.springer.com/book/10.1007/978-3-030-00069-1
- E. J. Kirkland, Advanced Computing in Electron Microscopy, 2nd edition, Springer (2010)