Pier Giorgio Merli (S)TEM SCHOOL IN MATERIALS SCIENCE.

October 3-7 2022 -Theory
October 10-14 2022-Practice

CNR-IMM Bologna
Via Gobetti 101, 40129 – Bologna, Italy
http://temschool.bo.imm.cnr.it

Directors:
Vittorio Morandi[1] and Andrea Parisini[1]

Teachers:
Roberto Balboni[1], Giovanni Bertoni[2], Regina Ciancio[3], Matteo Ferroni[4], Alessandro Gradone[1], Vincenzo Grillo[2], Raffaello Mazzaro[5], Andrea Migliori[1], Vittorio Morandi[1], Luca Ortolani[1], Andrea Parisini[1].

(1) CNR-IMM Bologna; (2) CNR-Nano Modena, (3) CNR-IOM Trieste, (4) University of Brescia; (5) University of Bologna.

Jointly organized by SISM and CNR-IMM Bologna.

The 8th edition of the "Pier Giorgio Merli" (Scanning) Transmission Electron Microscopy School, jointly organized by SISM and CNR-IMM, is finally scheduled to be held in early Autumn 2022 as an in-person event. In two full weeks, the School will provide students and researchers engaged in the materials science field (physics, chemistry, engineering) with a qualified introduction to Transmission and Scanning Transmission Electron Microscopy techniques.

In the first **week (October 3-7, 2022**), after an introduction to TEM and STEM instruments and their working principles, the theoretical background of SAED, CBED, HREM, HAADF-STEM, EELS, EDS and Holography techniques will be detailed. Examples of applications going from strain determination to materials characterization in solids and devices as well as compositional investigations, will be given. Finally, the main principles at the basis of the algorithms for diffraction and TEM and STEM image simulation will be introduced.

In the second **week** of the School **(*October 10-14, 2022*)**, the knowledge acquired during the first part will be put into practice. Students, under teacher's supervision, will operate on the 200 kV Schottky FEG TEM-STEM (FEI Tecnai F20 ST) installed at the CNR-IMM Institute. They will be also trained to the use of some of the available simulation and data processing software essential for (S)TEM work. Finally, examples of plan-view and cross-sectional TEM samples as well as FIB TEM lamellas preparations will be shown with a session in our laboratory and through a virtual stage at the Zeiss CrossBeam 340 installed at the CNR-IMM, respectively.

A certificate of attendance will be given to all the participants and upon request a certificate of the acquired skills, that may be also used for academic credits, will be issued after an examination. The official language is English.

Please refer to the School's web site, for a more complete description of the School's subjects: **http://temschool.bo.imm.cnr.it**

REGISTRATION

Registration to the school is obtained by signing up before September 30, 2022, directly on the SISM website **http://www.sism.it**

The "Pier Giorgio Merli" (S)TEM school is open to students from all countries. Regarding Europe, a current 2022 membership in any of the national European microscopy societies will be entitled to a reduced fee according to the following table:

	Researcher SISM-EMS member / Non member	Young scientist SISM-EMS member / Non member
Theory	600 € / 650€	400 € / 450 €
Theory (virtual)	400 € / 450 €	400 € / 450 €
Theory + Practice	1450 € / 1500 €	950 € / 1000€

For non SISM/EMS members, the registration to the school will give right and include a SISM membership for one year.

For any payment an invoice will be issued. Please note that, for employees of Italian public institutions, the fee is exempt from VAT (Article 10 of DPR 633/72).

Important notice: Applicants may choose to attend either the whole course or the theoretical part only (it is not possible to register for the practical course only). It will be also possible to attend the theoretical part as a virtual event. As to the practical course, the maximum number of participants is limited to **10**. After application acceptance, the School registration has to be completed on the same SISM web site. The School will take place only if a minimum number of **6** registrations to both the theoretical and practical courses will be reached.

PROGRAM OF THE THEORETICAL COURSE (October 3-7 2022)

Monday

008:3 REGISTRATION

09:15 OPENING

09:30 Early stage evolution of electron microscopy instruments.
M. Vittori Antisari

10:30 COFFEE BREAK

11:00 Instrumentation and Detectors
R. Ciancio

12:30 Electron Sources
V. Morandi

13:30 LUNCH

15:00 Electron Optics
M. Ferroni

16:30 COFFEE BREAK

17:00 Introduction to Aberrations Correction
L. Ortolani

18:00

Tuesday

09:00 Electron-Matter Interaction
R. Balboni

10:00 Radiation damage
R. Mazzaro

11:00 COFFEE BREAK

11:30 Electron diffraction 1
R. Balboni

13:00 LUNCH

14:30 Electron diffraction 2
R. Balboni

16:00 COFFEE BREAK

16:30 A Diffraction experiment: the Arago-Poisson spot
A. Parisini

17:30

Wednesday

09:30 Theory of Electron Diffraction 1
A. Parisini

11:00 COFFEE BREAK

11:30 Theory of Electron Diffraction 2
A. Parisini

13:00 LUNCH

14:30 X-ray Microanalysis of Thin Films
G. Bertoni

16:00 COFFEE BREAK

16:30 Electron Energy Loss Spectroscopy
G. Bertoni

18:00

Thursday

09:30 High Resolution Electron Microscopy 1
A. Parisini

11:00 COFFEE BREAK

11:30 High Resolution Electron Microscopy 2
A. Parisini

13:00 LUNCH

14:30 Scanning Transmission Electron Microscopy 1
V. Morandi

16:00 COFFEE BREAK

16:30 Scanning Transmission Electron Microscopy 2
V. Morandi

18:00

Friday

09:00 Electron Holography and Interferometric Methods
L. Ortolani

11:00 COFFEE BREAK_

11:30 Simulations in electron microscopy: image and diffraction
V. Grillo

13:00 LUNCH

14:00 Cryomicroscopy
To be defined

15:00 Company presentation
To be defined

16:00 Company presentation
To be defined

16:30 Company presentation
To be defined

17:00 Final Discussion and Closing Remarks

17:30

PROGRAM OF THE PRACTICAL COURSE (October 10-14 2022)

Monday

	Group A	Group B
13:00	REGISTRATION	
14:00	◉ Introduction to TEM **M. Ferroni**	Introduction to electron diffraction **R. Balboni**
15:30	COFFEE BREAK	
16:00	Introduction to electron diffraction **R. Balboni**	◉ Introduction to TEM **M. Ferroni**
17:30		

Tuesday

	Group A	Group B
09:00	◉ Electron diffraction **R. Balboni**	Diffraction pattern indexing **Migliori/Gradone**
10:30	COFFEE BREAK	
11:00	◉ Electron diffraction **R. Balboni**	Introduction to HREM **A. Parisini**
12:30	LUNCH	
14:00	Diffraction pattern indexing **Migliori/Gradone**	◉ Electron diffraction **R. Balboni**
15:30	COFFEE BREAK	
16:00	Introduction to HREM **A. Parisini**	◉ Electron diffraction **R. Balboni**
17:30		

Wednesday

	Group A	Group B
09:00	◉ HREM **A. Parisini**	HREM simulations **V. Grillo**
10:30	COFFEE BREAK	
11:00	◉ HREM **A. Parisini**	Image processing **L. Ortolani**
12:30	LUNCH	
14:00	HREM simulations **V. Grillo**	◉ HREM **A. Parisini**
15:30	COFFEE BREAK	
16:00	Image processing **L. Ortolani**	◉ HREM **A. Parisini**
17:30		

Thursday

	Group A	Group B
09:00	◉ STEM **V. Morandi**	TEM sample preparation **M. Ferroni**
10:30	COFFEE BREAK	
11:00	◉ STEM **V. Morandi**	FIB sample preparation **L. Ortolani**
12:30	LUNCH	
14:00	TEM sample preparation **M. Ferroni**	◉ STEM **V. Morandi**
15:30	COFFEE BREAK	
16:00	FIB sample preparation **L. Ortolani**	◉ STEM **V. Morandi**
17:30		

Friday

	Group A	Group B
09:00	◉ EDS spectra acquisition **A. Parisini**	EDS spectra processing **Migliori/Balboni**
10:30	COFFEE BREAK	
11:00	EDS spectra processing **Migliori/Balboni**	◉ EDS spectra acquisition **A. Parisini**
12:30	LUNCH	
14:00	CLOSING OF THE SCHOOL	
15:30		

◉ Hands-on TEM sessions