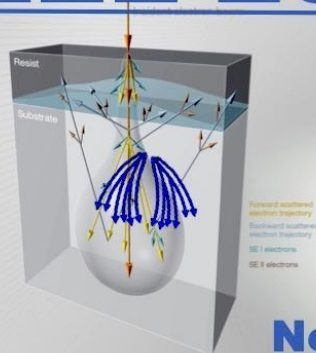


REPORT on the LEE 2023 meeting

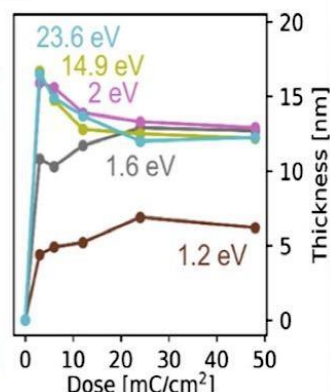
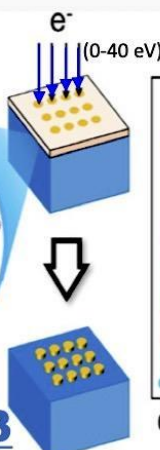
LEE 2023



<https://raith.com>



November 20, '23



ACS Appl. Mater. Interfaces 2020, 12, 9881-9889

A brain storming meeting on relevance of Low-Energy Electrons in nanolithography, electron-microscopy and adjacent fields



Organized in cooperation with Tor Vergata University
by Stefano Iacobucci & Giovanni Stefani (ISM-CNR)



Full interdisciplinary comprehension of Low Energy Electrons (0-50 eV) (LEE) generation and interaction dynamics is still missing, though it is relevant for a wondrous variety of technological challenges.

Filling this gap of knowledge is mandatory in order to enhance the nanolithography spatial resolution by controlling the LEE-induced chemical alteration of resists, to minimize the blurring effect in electron microscopy, to optimize the performances of electron-induced growth and operation of nanodevices, just to name a few.

Aim of the meeting is:

- to create a permanent network of fundamental and applied research;
- to establish an integrated path for acquisition and coordination of relevant information;
- to gather a community that coherently investigates the origin and effect of LEEs.

Active participation of the attendees to the final round table is envisaged to promote fruitful discussion.

The meeting can be attended either
in person at

Università degli Studi di Tor Vergata – Dipartimento di Ingegneria, Aula “Pitagora”
Via del Politecnico, 1- 00133
Roma, Italy

or
via Teams Platforms

info:
stefano.iacobucci@cnr.it

The meeting lasts
from 9:45 am to 6:10 pm

List of Speakers

ROBERTO FALLICA	IMEC (Belgium)	PETRA SWIDEREK	Bremen University (Germany)
ODDUR INGOLFSSON	Iceland University (Iceland)	STEFANO TURCHINI	CNR-ISM (Roma)
CHRISTOPHE INGUIMBERT	ONERA (France)	CLAUDIO VERONA	Tor Vergata University (Roma)
CORNELIS W. HAGEN	Delft University (NL)	JOHN S. VILLARUBIA	NIST (US)
ANDREA NOTARGIACOMO	CNR-IFN (Roma)	WOLFGANG WERNER	Technical University Vienna (Austria)
SYLVIE RANGAN	Rutgers University (US)		

The LEE 2023 brainstorming meeting on secondary (low energy) electrons (LEEs) was held in Università degli Studi di Tor Vergata – Dipartimento di Ingegneria, Via del Politecnico, 1- 00133 Roma, Italy on November 20, 2023. Similarly to the LEE 2022 edition (dedicated to role of LEEs in aerospace and nearby topics), the LEE 2023 meeting aimed at being an informal brainstorming on whatever is still to be understood on the LEEs role for technological challenges in nanolithography, electron microscopy and adjacent fields. LEE 2023 was attended by **43** researchers, **16** in person and **27** on-line from **18** different institutions, showing a significant increase in international participation in the meeting, 18 participants and 5 speakers from abroad

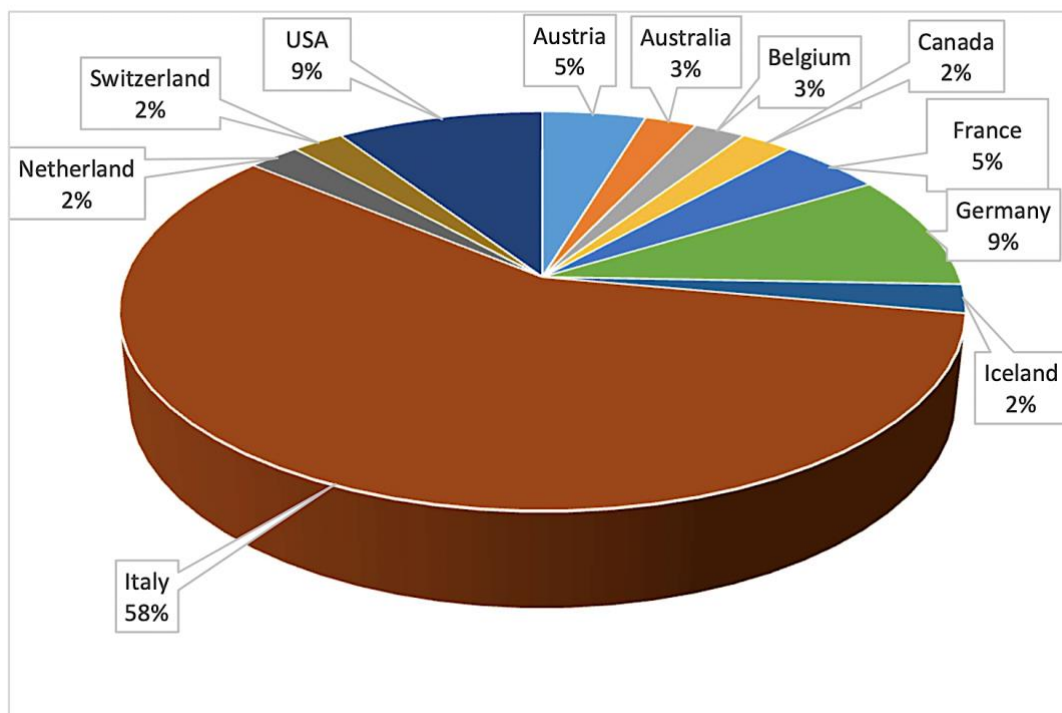


Fig. 1_ LEE2023 attendees by nationality

Motivations

Why focus on such a niche subject? Because LEE's are ubiquitous in many different branches of nowadays technologies. The main goal of the meeting is to gather ideas on how to establish a virtuous loop of questions and answers between application and basic research always mediated by applied research.

It was chosen to focus this second meeting on the relevance of LEEs knowledge in nanolithography and electron microscopy because the ultimate spatial resolution in both cases is limited by the blur due to secondary electrons. Why should we bother with LEE's if electron microscopes work at much higher energy and resist in nanolithography is activated by EUV radiation? Because interacting with matter all components behave as ionizing media thus producing primary electrons that further interacting with matter generate a stream of secondary electrons. It is common wisdom that a large majority of the secondary electrons are LEEs with energy between 0 and few tens of-eV, no matter which is the energy of the primary ionizing event. The secondary electrons energy distribution is the result of plural scatterings throughout the matter and to have full control of the genesis and evolution of LEEs it is needed:

- An accurate description of the individual electron collision
- A comprehensive model of the plural scattering chain
- A dependable model for qualitative and quantitative evaluation of the LEEs spectrum.

Such accurate knowledge is likely to be a key issue in pushing the EUV lithography FIB growth and electron microscopy resolution beyond their present limits.

Not always the aim is to limit the LEEs production the methods to estimate the efficiency of injecting LEEs by light absorption being crucial for photodetectors, photovoltaics and photocatalysis applications.

The tailoring of the excitation properties by materials properties provided a wealth of new phenomenology in the last decades. Furthermore, the control of secondary electrons induced reactions opens opportunities to tailor chemical reactions towards preferred induced chemical paths, All these issues, and even more, have been in depth treated by the speakers and amply debated from the floor. Abstracts and presentations can be found on the web site at the link <https://lee-meetings.ism.cnr.it/>

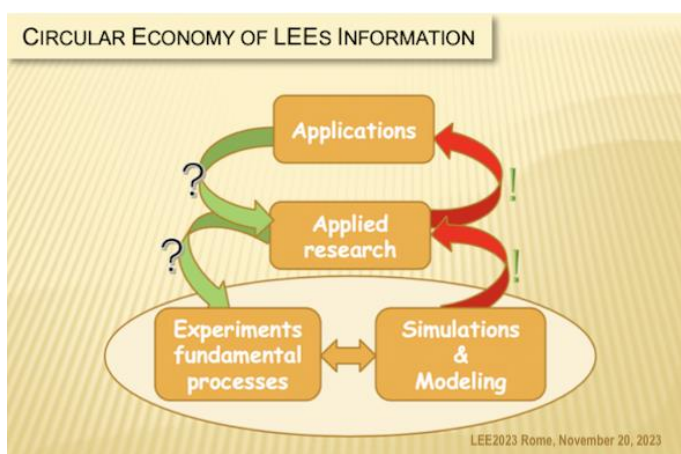
Conclusions

In summary, the meeting aimed at establishing a “Circular Economy of Information” in which hot questions percolate down from application through applied research to fundamental research, where experiments and simulations will work hand in hand in order to feed-up answers to applied research and ultimately to application.

The final discussion identified the need to stabilize the above-mentioned circulation of knowledge through concrete collaborative projects and in particular by seeking to train new researchers in this field. To pursue this latter aim, the conference organizers were instructed to collect expressions of interest in the drafting of a proposal for an EU Doctoral Network to be proposed by the deadline of November 2024.

Without false modesty, it can be said that the meeting achieved its goal.

Credits



Ending this report, it is the pleasure of the organizers to gratefully acknowledge the skillful support received from the technical staff of Tor Vergata University – Engineer Department, particular in persons of Mrs. M. Sgarlata, Mr. M. Di Genova and Mr. S. Bernabei.

The enthusiastic support granted by Prof. A. Di Carlo of Tor Vergata University and Dr. A. Cricenti, Director of CNR-ISM, is also gratefully acknowledged.