Integrating Nanoscience Laboratories and Analytical Research Infrastructures for future industrial challenges

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Nanoworld and materials science

Analytical Research Infrastructures

Characterization of materials **down to the nm scale in real-time**, in **operating conditions**.

Applications in Energy, ICT, Bio, health and food, electronics
Relationship RI-industry. 1

Industry as a provider

• Companies to ask RI for solutions.
• Patents and prototypes made by RI brokered to industries.
• Sharing objectives/solutions (RI to build an instrument, company to sell a new product)

Industry as a user

• Use specific skills of RI-researchers (routinely working with external users)
• Use top level, highly specialized instrumentation
• Access to RI for early stage basic research (often in cooperation with academic teams)
• Testing innovative developments, new protocols.
• Training
Move from the paradigm of "Technology Transfer" to the one of "Knowledge Transfer".

The science knowledge of industry needs to be increased, "co-creation” of solutions by scientists and industry is needed.

Figure 1. The virtuous circle of innovation

Key message, innovation panel, ICRI (Int. Conf. on Res. Infrastr. 2014)
Relationship RI-industry. 3

Removal of Grey zones

(IPR, "co-property“, publishing regime) not forgetting the specific needs of industry

Diversification of access mode (one-stop, collaboration, long term);
clear and transparent charging/fee rules and publishing policies

i. pure academic research (free of charges)
ii. industry-academic research (free or partial charges)
iii. programme-based cooperative research groups (external funding)
iv. proprietary research (at full cost).

Balancing activities (with flexible interfaces)

i. business-oriented activity/service
ii. Scientific/technical collaboration
iii. Not limited to proprietary research (science driven)

Involve industry at the very early stage

i. enhance capacities in going from prototypes to production
AN OPEN ACCESS RESEARCH INFRASTRUCTURE
for experimental & theoretical nanoscience
H2020 (Sept 2015 – Sept 2019)

The consortium
NFFA-Europe integrates 20 partners
half of which are nanofoundries
co-located with Analytical Large Scale facilities

Coordinated by CNR-IOM
The widest range of tools for research at the nanoscale
Free of charge access to academia & industry

- Access to distributed infrastructure, including provision of specialist service and expertise
- Direct interface with qualified personnel
- Access to top level equipments and laboratories
Flexible method for access and IPR

State of the art nanoscience laboratories co-located with the analytical RI (synchrotrons, free electron lasers, neutron sources)

NFFA-Europe is enhancing European industry competitiveness at three levels:

Providing firms a simple, coordinated access to large scale facilities and instruments: this fee-based access provides routine services and more complex project-based support, depending on your needs.

Giving SMEs opportunities to develop for free dedicated nanotechnology innovative solutions: this prefunded access allows SMEs to retain confidentiality.

Delivering to big companies the excellence of NFFA-Europe facilities at no charge, with obligation to publish results as open data.
A single entry point

For proposal submission

The access management structure ensures optimized service provision to users and guarantees scientific excellence and innovation of the selected proposals as collected via a Single Entry Point (SEP) portal with the assistance of the Technical Liaison Network (TLNet).

1. Browse the offer on the website www.nffa.eu
2. Free support from a team of technical experts (Technical Liaison Network)
3. Project submission on a single-entry point
4. Evaluation & ranking by an international peer-review panel
5. Free access to the identified installations & coverage of travel & accommodation costs

- Transnational access
- 80% of granted access project to EU & associated countries
- Disseminate results from access (except from SME)
- Support for travel & subsistence to users

First two calls, 60 projects submitted, 5 from industry
Transnational Access activities

Performed at nano-laboratories and ALSFs, will provide the opportunity to support comprehensive projects for multidisciplinary research at the nanoscale integrating theory and numerical analysis, structural and morphological characterization, electronic and chemical characterization, and magnetic, optical and electric characterization.

SINGLE ENTRY POINT

For more information, contact us with your project and connect now on the NFFA-Europe website
www.nffa.eu/industry

CONTACTS

Technical liaison manager  tlnet@nffa.eu
NFFA general contact  secretariat@nffa.eu

National Access activities

Open access facility to perform experiments in nanoscience that may involve growth, nano-characterization, theoretical simulation/modeling and spectroscopies at Synchrotron Radiation.

No deadlines for submitting proposals

INFO.TS@NFFA.EU

Future activities:
laser-based High Harmonic Generation source in collaboration with the T-Rex laboratory of Sincrotrone Trieste @FERMI
Rechargeable batteries lose capacity because of physical changes in the electrodes caused by electrochemical cycling.

J. Lim et al. Science 353, 566-571 (2016) @ ALS, Berkeley
A nanoview of battery operation

Single cathode particles for lithium-ion batteries are analyzed during cycling and discharge. Other factors, such as an asymmetric charge transfer coefficient (13), may also contribute to the observed hysteresis.

Our results show that spatial heterogeneities in reaction rates account for the compositionally nonuniform solid-solution domains during delithiation of Li$_x$FePO$_4$, and that the skewed $j_0$-$x$ relationship amplifies reaction heterogeneities during delithiation but suppresses them during lithiation, with theoretical predictions (44–45, 50). These results highlight the crucial role of surface reaction rate in lithiation with implications for electrode engineering and battery management. Heterogeneities in lithiation suppress compositional changes within the particles and have been shown to improve cyclability (4). However, the same statement is not true for delithiation, where reaction heterogeneities manifest as compositional nonuniformities beyond the particles, our work highlights the importance of compositional nonuniformities beyond the particles is less than the theoretical capacity. (B) Because the skewed $j_0$-$x$ relationship amplifies reaction heterogeneities during delithiation but suppresses them during lithiation, with theoretical predictions (44–45, 50). These results highlight the crucial role of surface reaction rate in lithiation with implications for electrode engineering and battery management.

REFERENCES AND NOTES

19. J. Lim et al., Science 353, 966-971 (2016) @ ALS, Berkeley Lab
The overall offer

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Transnational Access activities
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NA
Networking activities
designed and organized to foster an effective interface with the wide-ranging user communities. It will make experimental data suitable for industrial exploitation.

JRA
Joint Research activities
will develop methods and tools at the frontier in nanoscience research and will feed back into an improved offer of the research infrastructure to carry out academic as well as industrial projects.