NanoLab Talk

Politecnico di Milano, Department of Energy, Cesnef (Building 19), via Ponzio 34/3, Milan

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(in teleconference at this link: Join Microsoft Teams Meeting)

Chemistry in the World's Tiniest Test Tube

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How do we know that molecules react in one way rather than another? Conventional analytical techniques, such as spectroscopy or diffraction, can only support rather than confirm a chemical reaction mechanism. Ultimate knowledge of the reactions can be provided only by studying them at the single-molecule level. Carbon nanotubes, 80,000 times thinner than a single strand of human hair, allow us to entrap molecules and film chemical reactions triggered by heat, electric potential or electron beam with atomic resolution [1]. Reactions in nanotubes often deliver unusual products, such as graphene nanoribbons [2,3], or enable improvements of important physical and chemical processes. For example, loaded with metal nanoparticles the nanotubes exhibit remarkable catalytic properties that can be exploited in many applications, including electrocatalysis in fuel cells [4], outperforming traditional materials. All this becomes possible due to the world's tiniest test tubes.

References

[1] S. T. Skowron et al., Acc. Chem. Res., 2017, 50, 1797-1807.

[2] A. Chuvilin et al., Nature Mater., 2011, 10, 687-692.

[3] T. W. Chamberlain et al., ACS Nano, 2017, 11, 2509-2520.

[4] M. D. Gimenez-Lopez et al., Adv. Mater., 2016, 28, 9103-9105

About the speaker:

Andrei trained as a chemist (MSc Moscow State University 1997; PhD University of Nottingham 2002) and started his post-doctoral career at the Department of Materials, Oxford University (2002-2004). He applied transmission electron microscopy (TEM) for imaging structures of individual molecules and studying molecular dynamics in direct space and real time, which shed light on intermolecular interactions, and the translation and rotational motion of molecules at nanoscale. In 2004 he established the Nottingham Nanocarbon Group. His team discovered important mechanisms of interactions between carbon nanostructures and molecules or nanoparticles which enabled the design of nanoreactor systems with tuneable size and functionality. The nanoreactors have been applied for a range of reactions, including catalytic and electrochemical processes where molecular transformations are controlled at nanoscale. TEM remains key in his research, not only for the structural characterisation of individual molecules, but also as a new tool for the study and discovery of chemical reactions at nanoscale.

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