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Keynote: Nanomaterials and membranes interfaces by Atomic Layer deposition: design, properties and applications

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Prof. Mikhael Bechelany (born in March 1979) obtained his PhD in Materials Chemistry from the University of Lyon (France) in 2006. His PhD work was devoted to the synthesis and characterization of silicon and boron based 1D nanostructures (nanotubes, nanowires and nanocables). Then, he worked as a post-doc at EMPA (Switzerland). His research included the fabrication of nanomaterials (nanoparticles and nanowires), their organization and their nanomanipulation for applications in different field such as photovoltaic, robotic, chemical and bio-sensing. In 2010, he became a Scientist at CNRS. His current research interest in the European Institute of Membranes (UMR CNRS 5635) in Montpellier (France) focuses on novel synthesis methods for metals and ceramics nanomaterials like Atomic Layer Deposition (ALD), electrodeposition, electrospinning, 3D printing and/or on the nanostructuring using natural lithography (nanospheres and/or membranes). His research efforts include the design of nanostructured membranes for health, environment and renewable energy. Beginning of 2022, he is the author and co-author of more than 280 publications, 13 book chapters and 10 patents (h-index = 55). He is also the co-founder of 3 Startups.

ABSTRACT

Nanostructure science and technology are a broad and interdisciplinary area of research and development that has been exponentially growing in the past few years. Engineered nanomaterials are resources designed at the molecular (nanometer) scale to take advantage of their small size and novel properties which are generally not seen in their conventional bulk counterparts. The two main reasons why nanomaterials can have different properties are: (i) the increase of relative surface area and (ii) the quantum confinement effects leading to novel optical, electrical and magnetic behaviors. In order to apply these nanomaterials in different fields and to increase the throughput of nanostructured materials and membranes for energy, environmental and health applications, an efficient control of the interfaces is needed.

Here, we used different synthesis techniques such as atomic layer deposition (ALD) [1], as the main tools for the creation of controlled nanostructured materials and membranes in which the geometry can be tuned accurately and the dependence of the physical-chemical properties on the geometric parameters can be studied systematically in order to investigate their performances in energy, environmental and health applications. We will show examples of how these methods can be used to create single nanopores for sensing, membrane for gas purification [2,3], osmotic energy harvesting [4] and water treatment as well as sensors and biosensors [5], in which the performance varies with the nanostructures/interfaces.

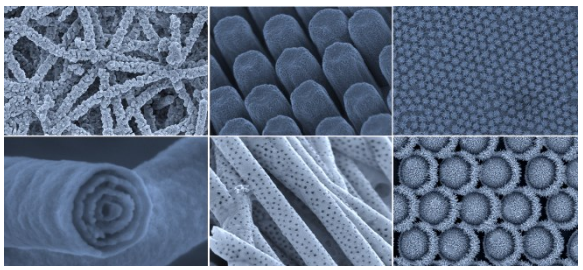

Figure 1: Design of nanomaterials for energy, environmental and health applications.

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