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Magnetic framework composites: Energy efficient materials for fine chemicals synthesis and fast adsorbent regeneration

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Composite magnetic catalysts and sorbents are leading candidates for catalytic applications under RF heating in flow. The development of supported catalysts with well-defined active structures that catalyse selective chemical transformations and have an additional functionality (e.g. light absorbing, microwave absorbing or magnetic properties) remains a major challenge. Successful development in this area could provide reactors and processes for synthetic routes and chemical products with optimal space-time yields, minimum waste production, minimum energy consumption, and minimum operating costs.

Ferromagnetic materials (like nickel ferrites) are known to generate heat when exposed to an alternating magnetic field in the radiofrequency range (RF). This property can be utilised for induction heating of a composite magnetic catalysts, where magnetic nanoparticles are embedded in the catalyst (sorbent) support. The control of magnetic material structure at the nanoscale is the key to increase performances and improve the energy efficiency under RF heating. Thanks to powerful characterization tools, we can now control critical catalyst parameters such as particle size, composition, shape, and particle-support interfaces. This has boosted numerous studies linking chemical processes, reactor design, nanostructures, and development of advanced kinetic models, paving the way for the rational design of nanostructured catalysts and structured reactors. In this lecture, recent developments in our lab in the area of magnetic framework composites and structured reactors will be discussed highlighting several examples of enhancement of reaction rate and selectivity under RF heating: from fine chemicals synthesis (direct amide synthesis and glucose isomerization in flow) to CO_2 capture and its subsequent transformation to solar fuels and chemicals.

Speaker Biography

Evgeny Rebrov got his PhD in Chemistry from Boreskov Institute of Catalysis in 1999. After 4 years of post-doctoral research work, he became Assistant Professor at Eindhoven University of Technology (the Netherlands). In 2007 he got a fellowship from the British Council-NWO partnership program in science and went to Cambridge University (UK). In 2009, he was appointed Visiting Research Professor at Wright State University (Dayton, Ohio). In 2010, he became Chair of Process and Reactor Engineering at Queen's University Belfast. In 2014, he took his present position at the University of Warwick. He is member of the Young Academy of Europe (YAE) and member of editorial board of AIMS Materials Science journal and member of international scientific committees of three international conferences. Evgeny Rebrov has published > 170 scientific papers in peer-reviewed journals and 9 book chapters (h-index =29). He is also co-founder and CTO at StoliCatalysts Ltd, an innovative award-winning SME, a spin-out of University of Warwick.

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