Advanced nanoarchitecture of iron and carbon based materials for environmental, catalytic and biomedical applications

Thursday December 4, 2014, University Campus Bohunice A11 - 132

Radek Zbořil

Regional Centre of Advanced Technologies and Materials, Palacky University Olomouc, Czech Republic

Iron and its compounds show a huge potential in various nanotechnologies owing to their low-cost, biocompatibility, non-toxicity, biodegradability, and environmentally friendly character. The broad scale of accessible valence states (0, II, III, IV, V, VI) and polymorphism of iron(III) oxide [1] contribute to the miscellaneous chemistry and quite unique portfolio of applications of Fe-bearing nanomaterials. In particular, nanoscale zero valent iron (nZVI, Fe^0) is viewed as an environmentally friendly tool for in-situ reductive treatment of ground water and surface water contaminated by, e.g., chlorinated hydrocarbons, uranium, heavy metals, or cyanobacteria [e.g. 2,3]. Nanocrystalline iron oxides in various structural forms have been found promising materials in biomedicine, biotechnologies, catalysis, photocatalysis of water or many magnetic applications. The control of the structural, morphological and surface properties of nanocrystalline iron oxides towards tailored applications in targeted drug delivery and MRI contrast enhancement, catalysis, and direct solar splitting of water will be presented [e.g. 4,5].

Carbon is another biocompatible element playing a crucial role in current nanotechnologies also due to the broad scale of various nanoallotropes including fullerene, nanodiamonds, nanotubes, carbon dots or graphene. Among them, the wet chemical strategies towards non-covalent and covalent functionalization of graphene and its derivatives will be discussed along with preparations, properties and theranostic applications of carbon dots [e.g. 6,7].

The last part of the talk will be devoted to various multifunctional hybrids of iron/iron oxides with carbon nanostructures and nanosilver with an emphasis on their applications in advanced water treatment technologies, antimicrobial treatment, heterogeneous catalysis and biomedicine [e.g. 8-10].

1) L. Machala, J. Tucek, and R. Zboril* CHEMISTRY OF MATERIALS, vol. 23, iss. 14, pp. 3255-3272, 2011.

2) J. Filip, F. Karlicky, Z. Marušák, P. Lazar, M. Cernik, M. Otyepka, and R. Zboril* THE JOURNAL OF PHYSICAL CHEMISTRY C, vol. 118, iss. 25, pp 13817–13825, 2014.

3) B. Marsalek, D. Jancula, E. Marsalkova, M. Mashlan, K. Safarova, J. Tucek, and R. Zboril* ENVIRONMENTAL SCIENCE & TECHNOLOGY, vol. 46, iss. 4, pp. 2316-2323, 2012.

4) D. Maity, G. Zoppellaro, V. Sedenkova, J. Tucek, K. Safarova, K. Polakova, K. Tomankova, C. Diwoky, R. Stollberger, L. Machala, and R. Zboril* CHEMICAL COMMUNICATIONS, vol. 48, pp. 11398-11400, 2012.

5) K. Sivula, R. Zboril, F. Le Formal, R. Robert, A. Weidenkaff, J. Tucek, J. Frydrych, and M. Graetzel JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, vol. 132, iss. 21, pp. 7436-7444, 2010.

6) V. Georgakilas, M. Otyepka, A. B. Bourlinos, V. Chandra, N. Kim, C. K. Kemp, P. Hobza, R. Zboril* and K. S. Kim, CHEMICAL REVIEWS, vol. 112, iss. 11, pp. 6156-6214, 2012.

7) K. Hola, Y. Zhang, Y. Wang, EP Giannelis, R. Zboril,* and AL Rogach NANO TODAY 2014, 10.1016/j.nantod.2014.09.004.

8) R. Prucek, J. Tucek, M. Kilianova, A. Panacek, L. Kvitek, J. Filip, M. Kolar, K. Tomankova, and R. Zboril* BIOMATERIALS, vol. 32, iss. 21, pp. 4704-4713, 2011.

9) V. Ranc, Z. Markova, M. Hajduch, R. Prucek, L. Kvitek, J. Kaslik, K. Safarova, and R. Zboril* ANALYTICAL CHEMISTRY, vol. 86, pp. 2939-2946, 2014.

10) J. Tucek, K. G. Kemp, K. S. Kim, and R. Zboril* ACS NANO, vol. 8, iss. 8, pp. 7571–7612, 2014.