The role of nanoscale secondary phases emerging from advanced technologies of water treatment (iron nanoparticles/ferratesIV,V,VI) in contaminants removal

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Recently, some of the advanced remediation technologies applied for organic/inorganic contaminants removal from polluted waters and soils are based on utilization of nanoscale zero-valent iron (nZVI) particles or iron(IV)/(V)/(VI) compounds (so-called ferrates). NZVI particles act as efficient reducing agent, while ferrates are used as oxidizing agents. In both cases, the reaction products (i.e., after nZVI oxidation or ferrate reduction) are nanocrystalline, frequently nearly-amorphous iron(III) oxides/oxyhydroxides either co-precipitating with targeted inorganic pollutants or further acting as sorbents. Based on experiments aimed at removal of various chlorinated solvents and metals under controlled laboratory conditions and detailed characterization of iron-based reaction products (i.e., employing instrumental methods including X-ray powder diffraction, Mössbauer spectroscopy, X-ray photoelectron spectroscopy, transmission electron microscopy), we have defined the mechanisms and efficiencies of contaminants removal, as well as the way of metals incorporation into secondary iron-based solid phases. The identified secondary phases are mainly represented by nanocrystalline maghemite [1], nearly-amorphous ferric oxyhydroxides, ferrous hydroxide, green rust or magnetite [2] depending on experimental conditions and used remediation technology. The results of laboratory experiments on model solutions [3] were compared with attenuation of metals from real contaminated waters (i.e., in laboratory-scale experiments) and also with results from localities treated by nZVI/ferrates in pilot scale. The authors gratefully acknowledge the support by the TAČR ("Competence Centres", project No. TE01020218).

[1] Prucek, Tuček, Kolařík, Filip, Marušák, Sharma & Zbořil (2013), *Environmental Science & Technology* **47**, 3283-3292. [2] Filip, Karlický, Marušák, Černík, Otyepka & Zbořil (2014), *Journal of Physical Chemistry C* **118**, 13817-13825. [3] Prucek, Tuček, Kolařík, Hušková, Filip, Varma, Sharma & Zbořil (2015), *Environmental Science & Technology* **49**, 2319-2327.