Magnetic $BaFe_{12}O_{19}$ nanofiber filter for effective separation of Fe_3O_4 nanoparticles and removal of arsenic

Jeehye Byun[1], Hasmukh A. Patel[1], Cafer T. Yavuz[1,*]

[1]Graduate School of EEWS, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 305-701, Republic of Korea. Fax: +82 42 350 2248; Tel: +82 42 350 1718; E-mail: yavuz@kaist.ac.kr ([*]Cafer T. Yavuz)

Magnetic nanoparticles are promising in applications where magnetic separation is intended, although materials losses via leaching mechanisms are often inevitable. Magnetic separations with widely available permanent magnets can effectively trap particles, leading to a complete removal of used or waste particles. In this report, we first demonstrate the synthesis of the thinnest (112.7 ± 16.4 nm) and most magnetic (71.96 emu g^{-1}) barium hexaferrite ($BaFe_{12}O_{19}$, BHF – fridge magnet) via an organic solvent-free electrospinning procedure. When the fibers are then packed into a column, they clearly remove 12 nm magnetite (Fe_3O_4) nanoparticles quantitatively. The same BHF cartridge also removes more than 99.9 % As-treated magnetite nanoparticles at capacities up to 70 times of its weight. As a result, one liter of 150 μg L^{-1} As-contaminated water can be purified rapidly at a materials cost of less than 2 US cents.