Supporting Information # 1: **Synthesis of barium hexaferrite core nanoparticles**

Nanoparticles $BaM_{10\text{-}70}$

First, the metal ions were precipitated from a solution containing 4.16 mmol Ba^{2+} ($Ba(NO_3)_2$) and 20.8 mmol Fe^{3+} ($Fe(NO_3)_3$) with the addition of 1.07 mol NaOH. The suspension of precursors was then sealed in an autoclave vessel and heated to 150 °C. After the autoclave cooled to room temperature, the product was washed with diluted nitric acid (to dissolve the Ba-rich phases that might form because of the excess Ba) and distilled water. After re-suspending the Ba-hexaferrite nanoparticles in water at pH = 4.7, the highly positive ζ-potential ensured their colloidal stability (Figure S1).

Nanoparticles BaM_{10} and BaM_{100}

The Ba-hexaferrite nanoparticles BaM_{10} and BaM_{100} were hydrothermally synthesized in the presence of oleic acid. First, the metal hydroxides were precipitated as described above. Oleic acid (0.01 mol) was slowly dissolved into the suspension of the hydroxides. During the hydrothermal synthesis with heating the autoclave to 240 ^{o}C the oleic acid adsorbed onto the surfaces of the formed nanoparticles and blocked their growth. As a result, the ultrafine nanoparticles BaM_{10} were obtained.

The larger platelet nanoparticles BaM_{100} were obtained with a hydrothermal synthesis with heating the autoclave to 270 ^{o}C. At these high temperatures above approximately 250 ^{o}C the oleic acid is no more effective in suppressing the nanoparticles' growth. The nanoparticles BaM_{100} underwent Ostwald ripening very rapidly, with the growth suddenly stopped when all the primary nanoparticles were consumed.

After the synthesis the hydrophobic Ba-hexaferrite nanoparticles were precipitated from the suspension with diluted nitric acid and washed several times with acetone. The oleic acid adsorbed onto the nanoparticle surfaces enabled their colloidal stability in nonpolar liquids. To prepare the stable aqueous suspension of the nanoparticles the oleic acid was exchanged with the citric acid in a ligand-exchange reaction. The oleic-acid-coated nanoparticles (1 g) were suspended in 1,2-dichlorobenzene and *N*,*N*-dimethylformamide (50:50, total volume 15 mL). The citric acid (0.002 mol) was added to the suspension followed by heating to 100 °C for 24 hours. After the reaction completed the nanoparticles were precipitated from the suspension by the addition of diethyl ether, washed with acetone and re-suspended in water. The adsorbed citric acid enabled a highly negative zeta-potential and thus the colloidal stability of the Ba-hexaferrite core nanoparticles in water (Figure S1).

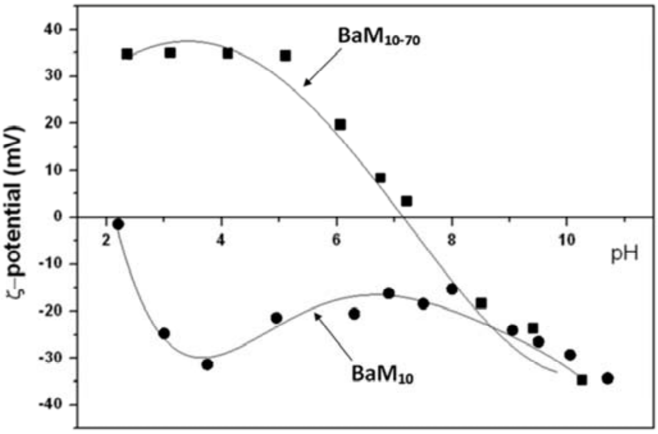

Figure S1: The ζ-potential of the $BaM_{10\text{-}70}$ and BaM_{10} nanoparticles as a function of the suspension pH.