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2nd International Conference on

MAGNETISM AND MAGNETIC MATERIALS

September 24-26, 2018 | Budapest, Hungary

Rafael A Prato M et al., Mater Sci Nanotechnol 2018, Volume 2

NANOMAGNETITE MAGNETIZATION ON DEMAND VIA A NOVEL ELECTROSYNTHESIS ROUTE

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A fast, environmentally friendly, room-temperature electrosynthesis route for magnetite nanocrystals is presented here. We use a gas diffusion electrode (GDE) to generate oxidants and hydroxide in-situ from air, enabling an oxidative electrosynthesis of particles from a single iron salt ($FeCl_2$). Upon applying a potential of -350 mV vs. Ag/AgCl at the GDE, oxygen is reduced to reactive oxygen species (ROS) which triggers a controlled oxidation of Fe^{2+} to Fe^{3+}, FeOOH and finally $Fe_{3-x}O_4$ are formed. The composition of non-stoichiometric magnetite can be finely controlled with the charge applied, which in turn determines the magnetic properties of the samples. In turn, the size of the nanocrystals can be tuned from 5 to 20 nm by changing the precursor concentration. The nanocrystals possess up to 85% of the bulk saturation magnetization of pure magnetite and minimal coercivity. Using air, NaCl and only $FeCl_2$, a remarkable level of control over the size and composition of nanomagnetite is achieved at room-temperature and in a fast, environmentally friendly, and reproducible manner.

BIOGRAPHY

Rafael A Prato M has completed his BSc in Chemical Engineering at the University of California Santa Barbara, USA, and his MSc in Chemistry at the University of Oslo, Norway. He is currently pursuing a PhD in Materials Engineering jointly at the KU Leuven and the Flemish Institute for Technological Research (VITO), Belgium.

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