"Student Poster Presentation"

Is 135° Ridge on The Lower Half of The First Order Reversal Curve Diagram an artifact?

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Abstract: First-order reversal curve (FORC) diagrams are a powerful method for the characterization of natural and synthetic magnetic particles. They are useful in analyzing magnetic mineralogy, particle size distribution, and degree of chemical alteration and magnetic interaction in nanoparticle systems. Several studies have reported an alternating ridge of positive and negative FORC density patches that extend away from the coercivity axis into the lower half a FORC diagram along an axis of 135°. Some authors have attributed this 135° ridge to be an artifact of data processing (e.g., Egli, 2013), while others have suggested that the ridge originates from interaction between two or more magnetic components with highly contrasting coercivities (e.g., Acton et al., 2007; Panagiotopoulos, 2011). This leaves an open question as to whether this ridge has a physical meaning. We present an experimental investigation on the appearance of the 135° ridge on FORC diagrams. Mixtures of two iron oxides, magnetite and hematite, with contrasting coercivities or biomimetic Fe-oxide nanoparticles that have undergone surface oxidation are explored. The results demonstrate that simply mixing two ferromagnetic materials with a large difference in coercivity, i.e., magnetite/maghemite and hematite, will not produce a ridge. This feature can be generated or removed, however, by changing the oxidation state of the magnetic nanoparticles. If the particles exceed a certain degree of oxidation, on the other hand, the ridge will no longer be found. These observations suggests that the occurrence of 135° ridge on FORC diagram is related to some degree of chemical alteration, i.e. oxidation of magnetite/maghemite to hematite in synthetic magnetic nanoparticles, so that the two phases have a common interface. The empirical results will be compared to a theoretical model, to better understand the conditions under which the 135° ridge will occur on FORC diagrams.

Keywords: First-order reversal curve (FORC); 135° ridge; coercivity; biomimetic Fe-oxide.

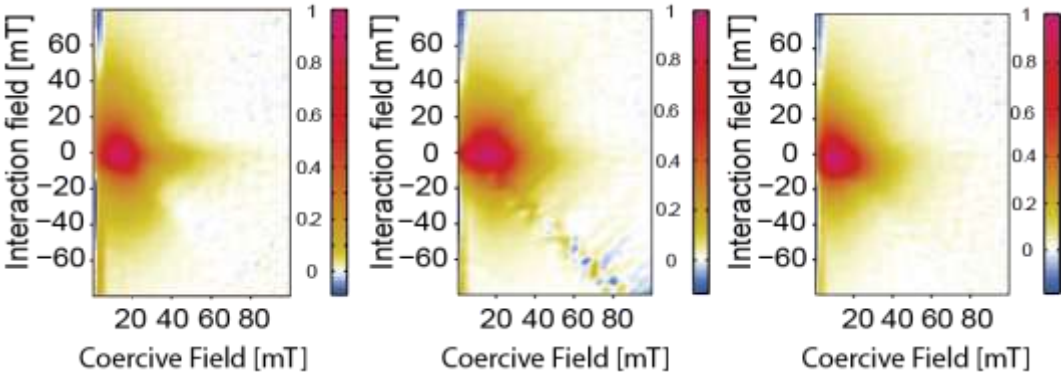

Figure 1: FORC diagrams of biomimetic Fe-oxide nanoparticles. a) Initial FORC distribution without the 135° ridge; b) appearance of the 135° ridge on the lower half of the FORC diagram after oxidizing the sample by heating in air; c) disappearnce of 135° ridge after reducing the oxidized sample in Ar atmosphere.

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