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Surface distortion of Fe dot-decorated TiO₂ nanotubular templates using time-of-flight grazing incidence small angle scattering

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Physical properties of nanoclusters, nanostructures and self-assembled nanodots, which in turn are concomitantly dependent upon the morphological properties, can be modulated for functional purposes. Here, in this article, magnetic nanodots of Fe on semiconductor TiO₂ nanotubes (TNTs) are investigated with time-of-flight grazing incidence small-angle neutron scattering (TOF-GISANS) as a function of wavelength, chosen from a set of three TNT templates with different correlation lengths. The results are found corroborating with the localized scanning electron microscopy (SEM) images. As we probe the inside and the near-surface region of the Fe-dotted TNTs with respect to their homogeneity, surface distortion and long-range order using TOF-GISANS, gradual aberrations at the top of the near-surface region are identified. Magnetization measurements as a function of temperature and field do not show a typical ferromagnetic behavior but rather a supermagnetic one that is expected from a nonhomogeneous distribution of Fe-dots in the intertubular crevasses.

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