Growth and Nitridation of Fe thin films on (0001) Al_2O_3 substrates

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Due to of its large saturation magnetization and possible large coercivity, $Fe_{16}N_2$ has been believed as a promising candidate material in the next-generation rare-earth-free permanent magnet applications. However, stabilization of this meta-stable phase has long been challenged. In this work, synthesis and nitridation of (110) Fe thin films on Al_2O_3 (0001) substrates were performed by RF magnetron sputtering and in-situ and ex-situ nitridation processes. From high resolution x-ray diffraction, we confirmed (110) epitaxial Fe thin films are successfully grown. We systematically studied magnetism and microstructures from vibrating sample magnetometer, scanning electron microscope, and atomic force microscope. In addition, we will show our on-going efforts to form $Fe_{16}N_2$ thin films from in-situ and ex-situ nitridation processes.

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