Transmission electron microscopy investigation of Fe_3O_4 films grown on Pt substrates

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Thin iron oxide films prepared by iron deposition with subsequent oxidation on Pt(111) single crystal substrates and Pt foils were studied by selected-area electron diffraction and high-resolution transmission electron microscopy (HRTEM). Oxidation of iron deposition leads to the formation of Fe_3O_4 films epitaxially on Pt(111) substrates with the relationships: $[111]_{Pt}$ // $[111]_{Fe3O4,}$ $[1\bar{1}0]_{Pt}$ // $[1\bar{1}0]_{Fe3O4}$. The misorientation of about ± 1.5° with respect to the Pt [111] was determined. Films contain antiphase boundaries (APB) between domains shifted by 1.86Å or 2.35Å relative to each other along the [111] direction. The films formed on Pt foils were polycrystalline. The lattice mismatch between Fe_3O_4 and Pt causes periodic arrays of strained regions in the oxide along the interface. The iron oxide lattice parameters near the interface are compressed by approximately 2%. Detailed analysis of the Fe_3O_4/Pt interface based on HRTEM images and image simulations show that the first layer of the oxide on the Pt substrate consists of iron atoms.