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Confinement effect induced high magnetic moment above room temperature of Co clusters in TiO₂

5% Co-TiO₂ film has been deposited using pulsed laser deposition. By delicately controlling deposition parameters, nanoclusters of Co are formed in the interface, confirmed by transmission electron microscopy, energy dispersive spectroscopy and X-ray absorption near edge spectroscopy. The film exhibits a very high saturation magnetization measured by magnetometer, equivalent to 6.54 $\mu\text{B}/\text{Co}$, given that the magnetic moment is all contributed from Co dopant. However, magnetic measurement by magnetometer can only give the overall information of the entire sample. To identify the surface dead layer and the magnetization in the interface where secondary phase or precipitation can easily be formed, we employed polarized neutron reflectometry (PNR) to identify the magnetic profile of the sample. From the peak of magnetic scattering length density, we can obtain that the highest saturation magnetization at the peak area is around 106 emu/cm³. The work indicates that very small nanoclusters under confinement environment can exhibit a very large magnetic moment above room temperature, which is promising for designing artificial high magnetization materials.

Topic

Advanced Materials

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