Large spin-dependent tunneling magnetoresistance in Fe3O4/PET heterostructures developed at room temperature: A promising candidate for flexible and wearable spintronics

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ABSTRACT

Half-metallic nanocrystalline magnetite (Fe3O4) thin films, with different thicknesses were developed on polyethylene-terephthalate (PET) substrates, by reactive sputtering at room temperature. Fe3O4 film (200-nm thick)/PET heterostructures possess superior electrical and magnetic characteristics, with a Verwey transition temperature (Tv) of ~122 K and a saturation magnetization (Ms) ~ 361 emu/cm³. Furthermore, the antiferromagnetic (AFM)-coupled antiphase boundaries (APBs) controlled the transport properties of the Fe3O4 thin films, due to the tunneling of spin-polarized electrons through the films. Very-high magnetoresistance (MR) value (~8.9%) were observed for HFilm plane, constructed from Fe3O4 (200-nm thick)/PET when H values were below 60 kOe at 300 K. In addition, flexibility tests, to examine resistivity, M-H and MR, were performed using with 90° and 45° bent angles and cyclability experiments were implemented to validate the reproducibility of these characteristics. These outcomes demonstrated that Fe3O4/PET heterostructures may represent a promising candidate for flexible/wearable spintronics.

KEYWORDS: Fe3O4/PET heterostructure; Saturation magnetization; Magnetoresistance; Verwey transition; Flexible spintronics

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