

# Large spin-dependent tunneling magnetoresistance in Fe<sub>3</sub>O<sub>4</sub>/PET heterostructures developed at room temperature: A promising candidate for flexible and wearable spintronics

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## ABSTRACT

Half-metallic nanocrystalline magnetite (Fe<sub>3</sub>O<sub>4</sub>) thin films, with different thicknesses were developed on polyethylene-terephthalate (PET) substrates, by reactive sputtering at room temperature. Fe<sub>3</sub>O<sub>4</sub> film (200-nm thick)/PET heterostructures possess superior electrical and magnetic characteristics, with a Verwey transition temperature ( $T_v$ ) of ~122 K and a saturation magnetization ( $M_s$ ) ~ 361 emu/cm<sup>3</sup>. Furthermore, the antiferromagnetic (AFM)-coupled antiphase boundaries (APBs) controlled the transport properties of the Fe<sub>3</sub>O<sub>4</sub> thin films, due to the tunneling of spin-polarized electrons through the films. Very-high magnetoresistance (MR) value (-8.9%) were observed for H/Film plane, constructed from Fe<sub>3</sub>O<sub>4</sub> (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 Fe<sub>3</sub>O<sub>4</sub>/PET heterostructures may represent a promising candidate for flexible/wearable spintronics.

**KEYWORDS:** Fe<sub>3</sub>O<sub>4</sub>/PET heterostructure; Saturation magnetization; Magnetoresistance; Verwey transition; Flexible spintronics

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