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Interfacial spin-structures in Pt/Tb₃Fe₅O₁₂ bilayer films on Gd₃Ga₅O₁₂ substrates

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The insulating ferrimagnets of rare-earth iron garnets (ReIG) are researched intensively owing to their strong magneto-electric responses. Proximity coupling between an insulating ReIG and a heavy metal, such as Pt has been shown to lead to an Anomalous Hall effect (AHE). Amongst the ReIG family, TbIG is less explored than the well-known YIG films. In this article, we report thin films (40 nm) of ferrimagnetic insulator Tb₃Fe₅O₁₂ (TbIG) were grown on (111) oriented Gd₃Ga₅O₁₂ (GGG) substrates by using pulsed laser deposition technique, some of which were capped by a thin Pt layer. Scanning transmission electron microscopy and X-ray diffraction show that the oxide films are epitaxial with high crystalline quality and sharp interfaces. Detailed polarized neutron reflectometry was used to study the spin structure above, below and near the compensation to search for interfacial spin effects. The neutron reflectivity with different states (spin up (R+) and spin down (R-)) and the spin asymmetry ($SA = (R+ - R-)/(R+ + R-)$) shows trends above 100 K consistent with the weak ferrimagnetic moment and compensation point. Remarkably, the PNR spectra at 7 K shows additional splitting of R+ and R- indicating strong magnetization on the magnetic film showing a new magnetic layer that arise, additional STEM mapping elucidate that this additional layer occurs at the TbIG/GGG interface, where a chemical difference in the ratio of Gd:Ga occurs as product of the growth conditions. This effect appears in both capped and Pt-free TbIG films. Reversal of AHE sign occurred between 145 K and room temperature. The peculiar behavior of AHE loop around 220 K is related to the compensation point of TbIG.

Presenter Gender

Woman

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

Students Only - Are you interested in AINSE student funding

Yes

Level of Expertise

Student

Pronouns

She/Her

Which facility did you use for your research

Australian Centre for Neutron Scattering

Primary author: Ms YADAV, Roshni

Co-authors: Mr BAKE, Abdulhakim; Prof. LEE, W. T.; Prof. LIU, Y. K.; Mr LIANG, J.M.; Prof. MITCHELL, David; Dr YUE, Zengi; Mr YANG, Xin-Ren; Dr LEUNG, Chi Wah; Prof. LIN, Ko-Wei; Dr CORTIE, David

Presenter: Ms YADAV, Roshni

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