MATERIALS ENGINEERING

SEMINAR

"Factors Affecting Gilbert Damping Parameter in Spinel Ferrite Thin Film Material System and Possible Solutions for Its Application in Spintronics"

By

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ABSTRACT

Current state-of-the-art technology electronics is plagued by energy dissipation in the form of Joule losses that in-turn reduce the efficiency for effective data storage and transport. Their possible alternative are devices that operate by utilizing spin wave excitation and propagation (magnons) in magnetic materials. An appropriate material system will exhibit ideal magnetization dynamics that enables efficient magnon transport with minimal losses. Thus, damping becomes a critical parameter to control the precessional motion of magnetization that determines how efficient is the magnon transport. In search for appropriate material systems, ferromagnetic alloys (Co, Fe, Ni) based thin films have been studied for their potential use in such devices owing to their low damping. However, due to the presence of conduction electrons in such material systems, electron magnon scattering often results in enhanced damping hindering their use in spintronics applications. Other materials such as garnets (YIG) despite possessing very low damping of the order of 10^{-4} require complex growth conditions that limits their integration in current CMOS fabrication process. Of note, such systems utilize traditional lithography for the fabrication of waveguide channels for magnon propagation limiting dynamic magnon transport control after device fabrication.

Insulator materials such as MgAl spinel ferrite - $MgAl_{0.5}Fe_{1.5}O_4$ have gained much attention as potential replacement materials owing to their much simpler synthesis process and CMOS-fabrication compatibility, thus making them a viable materials system. In this seminar, the major focus is on various factors that control the Gilbert damping constant in materials for magnonics applications. Understanding such dependence, aids in developing a better and more efficient material system. Improving the quality of epitaxial growth of magnetic thin film ensures that the film is coherently strained to the substrate and maintain its structural integrity without the formation of lattice defects at the film-substrate interface. Further, potential solutions to circumvent current challenges in spinel ferrite-based materials systems are also discussed.

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