第112回 磁性研ゼミナール

開学40周年記念事業

The 112th Magnetics Lab Seminar

Materials and components for integrated spin-wave devices

15:00-16:00, 16th, March
Room C-204,
Toyohashi Univ. of Tech.

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Research on integrated spin-wave devices recently gained momentum due to the development of high-quality magnetic insulating thin film iron garnets with ultra-low Gilbert damping as well as the capability to pattern films on the sub-100 nm scale over cm²'s of chip area. These insulating films enable researchers to fabricate spin-wave logic gate devices with zero or low Ohmic dissipation at operation frequencies from 5 GHz to at least 7 THz (1st Brillouin zone of Yttrium iron garnet). Each magnetic insulating logic gate architecture enables substituting more than 20 transistors and simplifies geometric and fabrication constraints. Since these devices operate at radio-frequency bands, contactless wiring becomes possible using antennas and integrated circuit routing is also simplified. These functional capabilities enable researchers to circumvent the major limitations of complementary metal-oxide semiconductor (CMOS) such as Ohmic dissipation, sub-10 nm fabrication and expensive fab management requirements. In this presentation, we first discuss our recent studies on the magnetic insulator thin films with low-damping and in-plane (YIG, $Y_3Fe_5O_{12}$) and out-of-plane (TmIG, $Tm_3Fe_5O_{12}$) anisotropy. In the second half of our presentation, we discuss 3 different spin-wave device applications using magnetic insulators: 1) spin-wave injection into magnetic insulators using spin-orbit torques, 2) spin-waveguiding using magnetic insulators and 3) control and local measurement of spin chemical potential in a magnetic insulator.

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