Magnon transport in YIG/GGG at millikelvin temperatures

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Yttrium-iron-garnet (YIG) is the ideal choice of material to build and develop classical and novel quantum technologies [1]. Performing propagating spin-wave spectroscopy on thin films at millikelvin temperatures is the next step toward the realization of large-scale integrated magnonic circuits for quantum applications. In the talk, I will demonstrate spin-wave propagation in a 100 nm-thick YIG film at temperatures down to 45 mK [2]. The clear transmission characteristics over the distance of 10 μm are measured from which the extracted spin-wave group velocity and the YIG saturation magnetization agree well with the theoretical values. It was also found that the magnetic moment induced in gadolinium-gallium-garnet (GGG) substrate at low temperature disturbs the magnon transport for the applied magnetic fields beyond 75 mT. To address this phenomenon, the magnetization of the GGG substrate was measured via vibrating-sample magnetometry, and the magnetic properties of the YIG film were characterized by ferromagnetic resonance (FMR) measurements. It is found that the magnetization of GGG results in the formation of a stray field oriented in the opposite direction to the external field. Moreover, the magnetization of GGG increases the magnetic damping of YIG by more than eight times compared to measurements at room temperature.

References:

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