Lattice-Tunable Substituted Iron Garnets For Cryogenic Magnonics

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Magnonic platforms are envisioned for use in hybrid quantum systems, where magnons coherently interact with microwave and optical photons, providing quantum transduction and sensing capabilities [1-3]. In the context of quantum information technologies, low-temperature magnonic devices are also of increasing interest for scaling and enabling new functionalities in cryogenic microwave electronic components. So far, these are mainly based on bulk magnetic insulators, which are not convenient for integration.

In this talk, we will review our recent work on the integration of epitaxially grown thin films of magnetic insulators into cryogenic magnonic devices. Past developments in this field have been limited to liquid nitrogen temperatures [4] due to the detrimental paramagnetism of gadolinium gallium garnet (GGG), the substrate of choice for epitaxy of yttrium iron garnet (YIG). In recent years it has become clear that to obtain thin epitaxial films of iron garnet with highly coherent magnetization dynamics and without microwave losses at 4 K and below, GGG should be eliminated [5,6]. To this end, we have explored alternative iron garnet compositions on yttrium scandium gallium garnet (YSGG), a diamagnetic substrate. I will show that this allows for improved ferromagnetic resonance under cryogenic conditions [7-9]. I will also present the prospects for new devices and their measurements [10,11], as first steps taken in our group towards quantum magnonics.

References

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