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Tunable Room Temperature Skyrmions in Ir/Fe/Co/Pt Multilayers

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Magnetic skyrmions are nanoscale topological spin structures offering great promise for next-generation information storage technologies. The recent discovery of sub-100 nm room temperature (RT) skyrmions in several multilayer films has triggered vigorous efforts to modulate their physical properties for their use in devices. Here we present a tunable RT skyrmion platform based on multilayer stacks of Ir/Fe/Co/Pt, which we study using X-ray microscopy, magnetic force microscopy and Hall transport techniques[1]. By varying the ferromagnetic layer composition, we can tailor the magnetic interactions governing skyrmion properties, thereby tuning their thermodynamic stability parameter by an order of magnitude. The skyrmions exhibit a smooth crossover between isolated (metastable) and disordered lattice configurations across samples, while their size and density can be tuned by factors of 2 and 10 respectively. We further investigate their electrical signature using a combination of transport and imaging experiments, and explore their nucleation and stability in patterned nanostructures down to 100 nm. We thus establish a platform for investigating functional RT skyrmions, pointing towards the development of skyrmion-based memory devices. [1] A. Soumyanarayanan et al., arXiv:1606.06034 (2016).