A Quantum Upgrade of Nonlinear Spectroscopy

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Direct measurement of the intrinsic magnetization in the bulk of thin-film or two-dimensional materials is important to understanding quantum phenomena in low-dimensional systems and designing advanced spintronic devices. However, the task is challenging since the stray fields from the bulk vanish and those from the boundaries are subjected to the complications of surfaces. Here, we develop a non-destructive detection method combining nanoindentation and nitrogen-vacancy (NV) magnetometry. We employ an atomic force microscopy (AFM) tip to apply reversible deformation to thin-film iron magnets and therefore induce leakage of stray fields from the bulk of the materials and optically detected magnetic resonances of NV centers in nanodiamonds near the nano-indentation to measure the stray fields. This work provides a direct access to the intrinsic magnetic properties of thin-film and low-dimensional materials.

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