

# Coupling Spin Defects in Hexagonal Boron Nitride to Monolithic Bullseye Cavities

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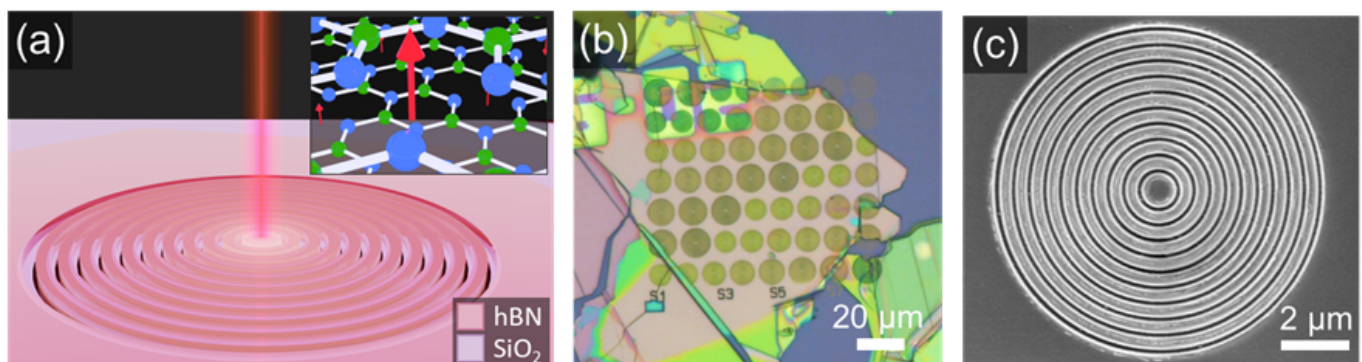
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Quantum emitters in the two-dimensional material hexagonal boron nitride (hBN) are being studied as increasingly important fundamental components for quantum photonic applications. In this work we efficiently couple recently discovered spin defects in hBN to purposely designed, monolithic bullseye cavities. We show a 6.5-fold PL enhancement from the boron spin vacancy when coupled to the monolithic hBN cavity system along with improved contrast and signal to noise ratio in optically detected magnetic resonance readout. Through comparison to finite-difference time-domain modeling we also determine the dipole orientation of the emission, which, at this point, had not been experimentally observed. Our results and supporting simulations therefore constitute an initial step towards integration of hBN spin defects with photonic resonators for a scalable spin-photon interface.



**The Bullseye Cavity.** a) A schematic of a hBN bullseye cavity on SiO<sub>2</sub> generating collimated emission into free space. The top right inset shows a schematic of the VB- spin defect in the hBN lattice, where nitrogen and boron are depicted as blue and green spheres, respectively. The optically active VB- spin defect is illustrated as a red arrow. b) Optical microscope image of an exfoliated hBN flake on 285 nm SiO<sub>2</sub> with an array of fabricated devices. The various colors of the flake correspond to different thicknesses. c) An SEM image of a bullseye cavity.