Abstract

Atom-like defects in diamond can possess coherent optical transitions linked to long-lived electronic spins, providing a promising spin-photon interface for applications in quantum information and sensing. Already, such emitters have been leveraged in seminal demonstrations of memory-enhanced quantum communication1 and multi-node quantum networks2. Moreover, diamond defects have been used to detect the minute magnetic fields generated by exotic materials, nanoscale currents, and single- to few-nuclear-spin samples3. Despite this remarkable progress, further advances are limited by either the optical or spin properties of popular defects. My research aims to identify and leverage new emitters that possess the best of both worlds, facilitating efficient spin-photon transduction of long-lived electronic spins. Such systems would vastly improve scalability for future quantum networks based on diamond defects and enable a new sensing modality capable of detecting single nuclear spins in external molecular targets.

1) M. Bhaskar et al., Nature 580, 60-64 (2020).

2) M. Pompili et al., Science 372, 259-264 (2021).

3) I. Lovchinksy et al., Science 351, 836-841 (2016).