MAR17-2017-020854

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Single Quantum Defects in h-BN and ZnO[1]

NICHOLAS R JUNGWIRTH, Cornell University

Isolated point defects in wide bandgap semiconductors are single photon sources with applications in quantum optics, precision sensing, and quantum information processing technologies. Although the nitrogen-vacancy center in diamond has garnered the most attention, efforts to discover novel defect-based single photon sources have uncovered promising candidates in SiC, ZnO, and hexagonal boron nitride (h-BN). I will discuss our progress on identifying and characterizing isolated defects in ZnO and hBN. First I will report confocal fluorescence measurements of isolated defects in ZnO that exhibit single photon emission when excited by sub-bandgap energy light. Single-defect absorption (emission) polarization measurements reveal the presence of a single absorption (emission) dipole as opposed to multiple dipoles. We find that the absorption and emission dipoles are aligned parallel to one another within experimental uncertainty. Lastly, we analyze these polarization spectroscopy measurements in the context of point group theory. This approach enables us to infer the allowed symmetry properties of the defect's ground and excited state wavefunctions for several possible spatial symmetries common to the ZnO wurtzite lattice. Next I will discuss the distribution and temperature-dependent optical properties of zero-phonon emission from isolated defects in h-BN flakes. We observe sharp, single-photon emission lines distributed across an energy range that exceeds 500 meV. We also present a detailed study of the temperature-dependent linewidth, spectral energy shift, and intensity for two different zero-phonon lines centered at 575 nm and 682 nm. Our temperature-dependent results are well described by a lattice vibration model that considers piezoelectric coupling to phonons in the defect's particular two-dimensional h-BN sheet.

[1]We acknowledge support from the NSF (DMR-1254530).