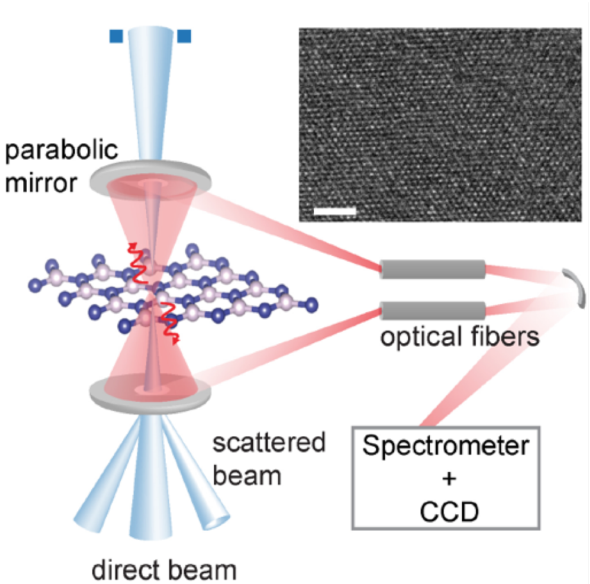
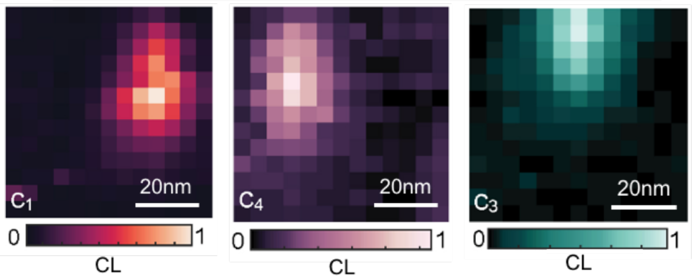
Submitted
Jan. 2020

Atomic-scale optical characterization of quantum materials reveals unique classes of color centers





Atomic-scale optical characterization of materials, such as quantum emitters in hexagonal boron nitride, is enabled with light-coupled transmission electron microscopy (TEM). Our work revealed 4 distinct classes of color centers with distinct emission wavelengths, charge states, and local strain.

Scientific Achievement

We developed a characterization method to correlate the optical properties of atomic-defect-based quantum emitters with their atomic and crystallographic structure.

Significance and Impact

Next-generation quantum and energy technologies will require bright, controllable emitter characteristics and placement. Our research provides a foundation for creating such emitters based on atomic "defects-by-design".

Research Details

- we combine photoluminescence (PL), cathodoluminescence (CL) and nano-beam electron diffraction.
- across 40 emitters, we identify 4 unique emitter classes: type 1 (only CL active, 650nm); type 2 (identical CL and PL, 625nm); type 3 (shifted CL-PL, 700nm); and type 4 (580nm).
- Complexes of C_BV_N, N_BV_N , $O_{2B}V_N$, as well as V_N with interstitials, are the likely candidates

Work was performed at Stanford University and Harvard

F. Hayee, P. Narang, T. Heinz, J. Dionne, et al, Nat. Mat. in press (2020)

U.S. DEPARTMENT OF ENERGY | Office of Science

PTL PHOTONICS AT THERMODYNAMIC LIMITS

Stanford University · Berkeley University of California · Harvard University · Caltech · Illinois