Single photon source technology shows great promise in fields ranging from quantum information processing to imaging cells in-vivo.[1] Hexagonal boron nitride (hBN) is a wide bandgap low-dimensional material, and point defects of its atomic lattice have shown to be robust, ultrabright single photon emitters.[2] Proposed devices based on such defects promise the measurement of currents and electric fields at the smallest scales. However, the atomic structures of such point defects are still under debate. For example, multiple defect structures have been theorized with some of the most promising candidates suggested being carbon-based defects (C_BV_N) and negatively charged boron vacancies (V_B^-), but direct evidence of such structures remains elusive. Imaging defect structures at the atomic scale using transmission electron microscopy (TEM) would confirm the existence of such structures in hBN. However, this method provides its own unique challenges such as mitigating damage electron knock-on damage. In order to analyze atomic-scale images, our group employs the combination of structural simulation, multislice TEM image simulation, and convolutional neural networks (CNNs) to image samples without damaging them. In this presentation I describe the applications of single photon sources, the properties of hBN defects, and methods for fabricating and identifying such defects.

[1] Prineha Narang et al, Advanced Functional Materials, 1904557 (2019) 1

[2] Toan Trong Tran et al, ACS Nano 2016 10 (8), 7331-7338