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Thesis abstract

Quantum emission from hexagonal boron nitride

Trong Toan Tran

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Realization of quantum technologies demands successful assembly of crucial building blocks. Quantum light sources, lying at the heart of this architecture, have attracted a great deal of research focus during the last several decades. Optically active defect-based centres in wide bandgap materials such as diamond and silicon carbide have been proven to be excellent candidates due to their high brightness and photostability. Integration of quantum emitters on an on-chip integrated circuit, however, favours low dimensionality of the host materials. In this thesis, we introduce a class of novel quantum systems hosted in hexagonal boron nitride (hBN) — a wide bandgap semiconductor in the two-dimensional limit. We demonstrate that the quantum systems possess a record high single photon count rate, exceeding 4 megahertz at room temperature, extremely high stability under high excitation at ambient conditions, and fully linear polarized emission. Spin-resolved density functional theory calculation suggests that the defect centre is an antisite nitrogen vacancy. Furthermore, we demonstrate engineering of quantum emitters from hBN by a range of nanofabrication techniques and that resonant excitation of the emitters is achievable. Coupling of quantum emitters in hBN to plasmonic particle arrays is also demonstrated, showing several times the Purcell enhancement factor.

Dr Trong Toan Tran,
School of Mathematical and Physical Sciences,
Faculty of Science,
University of Technology Sydney,
Sydney NSW 2007
AUSTRALIA

E-mail: trongtoan.tran@uts.edu.au

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