URSI - RCRS 2022, IIT (Indore), India, 1 - 4 December, 2022

Single Crystal Diamond and Carbon Nanotube-Based Quantum Emitters

Padmnabh Rai, and Vivek Kumar Shukla
School of Physical Sciences, UM-DAE Centre for Excellence in Basic Sciences, University of Mumbai, Kalina, Santacruz (E), Mumbai-400098, India, e-mail: padmnabh.rai@cbs.ac.in

Carbon-based materials such as carbon nanotube, graphene and single crystal diamond are emerging as potential materials for nanoscale photonic and optoelectronic applications. Quantum information processing has emerged as a key area of research, because quantum computing is of current importance both for basic science and for technological advancement.

Apart from purely semiconductor-based approach, diamond has emerged as an interesting alternative as single photon emission source is prerequisite in the field of quantum technology and nitrogen-vacancy (NV) centre in diamond is one of such sources. Next generation quantum devices require NV centre-based wafer scale single diamond with precise electronic and optical properties. Microwave plasma chemical vapor deposition technique was employed to grow wafer scale NV centre incorporated single crystal diamond. Single photon emission measurements were performed on various diamond samples to understand the quantum behaviour of light due to the presence of nitrogen vacancy centres. A sharp decay in the value of second-order correlation function ($g^{(2)}(0) < 0.5$) at zero-time delay was found, which reflects anti-bunching behavior of light emerging from nitrogen-vacancy centre in wafer scale diamonds.

Carbon nanotube has been explored as a nanoscale optical source for launching surface plasmon and quantum emitters for momentum space Raman spectroscopy. The momentum spectroscopy of Raman scattering of the carbon nanotube demonstrates the direct verification of momentum selection rules and identifies the characteristic bands of the molecules under investigation.

Thus, carbon-based materials provide a common platform, where electronic, optoelectronic and photonic devices can be integrated on the same material in the next generation chip-scale technology.

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