C2N Seminar

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Room A003 at C2N

Coupling organic molecules to nanophotonic structures

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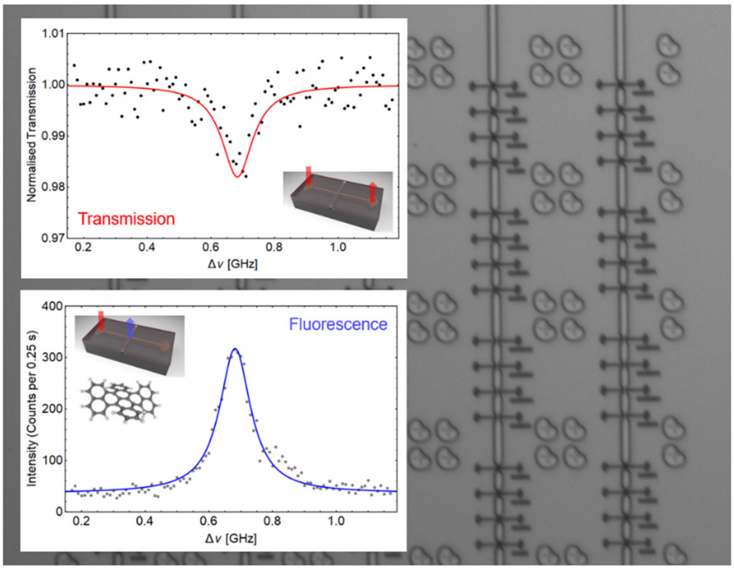
Photons lie at the heart of many quantum technologies. They are the only logical choice for sending quantum information over long distances, they have been used for many demonstrations of quantum simulations, they are often employed in microscopy to perform high-resolution imaging and they are promising candidates for quantum computing and networking. Still, they are difficult to generate and collect with high efficiency. In this talk I will discuss the use of organic molecules for generating, processing and storing single photons. When dibenzoterrylene (DBT) is embedded in anthracene it is photostable and forms a two-level system which when excited will emit a photon at a wavelength of ~780 nm. This is desirable as a number of atomic quantum technologies based on rubidium interact efficiently with light at this wavelength. When cooled to 4K, DBT can be used to generate coherent, lifetime-limited photons. I will show our work in characterising a single molecule at temperatures down to 4 K and show that coherent Rabi oscillations are then seen in the excited state population. I will then discuss our recent work to couple the emission from single molecules into nanophotonic waveguides including hybrid plasmonic systems and dielectric nanowire waveguides crossed with organic filled micro-capillaries. Finally I will discuss the use of nanophotonic and optical fibre cavities to further enhance the collection of photons from single molecules.



The background is a white light image of an array of silicon nitride waveguides crossed by microcapillaries. Once filled with DBT-doped anthracene we see dips in waveguide transmission caused by coherent interference between the excitation laser and light scattered by DBT, and at the same time we see peaks in fluorescence captured out-of-plane with a confocal microscope.

Dr Alex S. Clark is a Royal Society University Research Fellow working on Organic Molecular Quantum Photonics. He heads the Quantum Nanophotonics Project in the Centre for Cold Matter, and is Work Package Leader on Interfaces in the EPSRC Programme Grant "Quantum Science with Ultracold Molecules (QSUM)." His current research interests lie in the use of molecules to build new quantum technology and explore quantum science, such as creating on-demand photon sources, quantum memories, photonic quantum gates, and hybrid interfaces to link disparate quantum systems.

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