Photostable Molecules on Chip: Integrated Single Photon Sources for Quantum Technologies

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Efficient quantum light sources and non-linear optical elements at the few photon level are the basic ingredients for most applications in nano and quantum technologies. On the other hand, on-chip integration is necessary to envision a scalable platform for quantum information and communication.

In this work we demonstrate the potential of a novel hybrid technology which combines single organic molecules as quantum emitters and dielectric chips, consisting of ridge waveguides and grating far-field couplers [1]. Dibenzoterrylene molecules in anthracene crystals are particularly suitable quantum systems for this task, due to outstanding photophysical properties [2,3] in samples as thin as few tens of nanometers. Here the emitters are integrated by spin-coating onto the photonic chip. We demonstrate at room temperature the emission of single photons from DBT molecules into ridge waveguides with a branching ratio up to 40%, corresponding to an estimated in-guide brightness around 50MHz for cw pumping at saturation intensity. These results are competitive with state-of-the-art single photon emission into propagating guided modes from solid state systems [4,5], while offering a novel platform with unprecedented versatility. Single waveguided photons can be readily processed on-chip or extracted into a quasi-gaussian mode in free space with overall efficiency around 16%. We also discuss options to further improve the collection efficiency and applications to quantum optics [6] and to study manybody-induced quantum correlation effects [7].

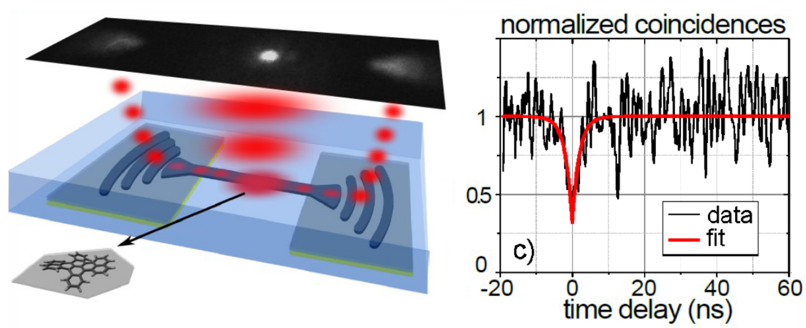

Figure 1: Cartoon and fluorescence image collected with an EMCCD camera showing signal from both the confocal excitation spot and the outcouplers; antibunching dip measured in correspondence of all output ports revels single-photon nature of the signal.

References

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