OLEIT
ORGANIC LIGHT EMITTERS FOR INFORMATION TRANSFER

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Project context and objectives

The project OLEIT has the ambition to integrate single Dibenzoterrylene molecules (DBT:AC) photon sources on a microstructured device for on-chip optical communications. The building-block we have engineered is a hybrid device, combining long distance propagation into dielectric waveguides with enhanced fluorescence, by means of plasmonic antennas. There are three main challenges we had to face with respect to state-of-the-art technologies. The first one concerned the design of appropriate interfaces between molecules and waveguide on a substrate, the presence of which strongly affects antenna efficiencies. The second one is to combine different fabrication techniques so as to produce efficient hybrid dielectric-metallic functional structure. Finally we had to develop nanomanipulation schemes for single molecules, enabling highly accurate a-posteriori on-chip positioning of emitters. Our final goal is to combine DBT nano-manipulation with the fabricated hybrid sample to attain single photon generation and propagation on a chip.

Brief description of the main results

With respect to the aforementioned objectives, we have been able to design two basic structures with high coupling efficiencies (above 50%), one which we will refer to as “Y” coupler (because of the shape of the plasmonic guide) and a second one based on a modified Yagi-Uda antenna. The Y coupler is designed to couple light from dielectric waveguides into a specific mode of a plasmonic waveguide providing access to strong near-field. The Yagi-Uda type structures are instead designed to serve as direct interlink between single molecules coupled to the feed antenna and a dielectric waveguide. Both designs have hence been fabricated and are currently under characterization. In parallel we have tested nanopositioning of DBT dye-molecules with an AFM tip. The result is a good proof of principle of the technique, which has now to be transferred to the photonic micro-structured device.

Final results, potential impact and use

In conclusions, after 5 months of the project OLEIT, we have all the ingredients to efficiently couple an organic-molecule-based single photon source to a photonic chip for information transfer. Narrow band emission, constant emission rate and small scale will be the hallmark of our device. We

certainly intend to follow up on this project, as there are several test measurements which still need to be performed. Having realized the building block of such a high throughput photonic circuit, a wealth of applications for onchip optical communication become within reach.