Hybrid Nanostructures for Emissive devices

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Organic semiconductors have been used for many applications, especially in the development of low cost, broadly tunable light emitting devices, such as LEDs and lasers, in the visible range. Nevertheless, all organic semiconductor lasers to date have been pumped optically, and their electrical pumping is still major challenge.

Current developments in the field indicate that:

- indirect electrical pumping in hybrid structures is a very promising strategy to build an eletrically driven organic laser;
- non radiative Forster energy transfer (FRET) can be more efficient than radiative energy transfer in converting the excitation electrically generated inside the inorganic component into light emission from the organic material;
- it is now possible to grow some crystals from melt directly in a microcavity with the desired thickness;
- some organic single crystals show lasing oscillations and ASE with a very low threshold even at room temperature.

The project aims at measuring the efficiency of hybrid structures based on organic single crystals coupled through FRET to InGaN QWs, as a first step toward the realization of an electrically driven organic laser. The key-points of the project are:

- the development of the technique of crystal growth from melt, with the definition of a protocol for building well controlled and reproducible hybrid structures;
- the study of FRET efficiency in single crystal based hybrid structures and the theoretical modeling of the energy transfer process;
- the comparison of FRET efficiency for different morphologies of the emitter, which will consist of a single crystal, a film or dispersed molecules;
- the test of the possibility to obtain FRET pumped ASE in hybrid structures.

The project is framed in the field of hybrid nanostructures and is aimed at improving the knowledge of the FRET mechanism as well as its efficiency in view of possible applications to electrically driven organic lasers or LEDs. At the same time, the project is expected to develop a growth method which can turn single crystals into very attractive materials not only for fundamental research but also for applications.