Towards Electrically Pumped Lasing Emission in Thin Organic Films

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Laser emission generation has been instrumental in science and industry for decades. In particular, compact solid-state lasers stand out regarding the lasing emission usage in disposable characterization devices, a range of consumer electronics items, and other optoelectronic devices.

The use of some organic light-emissive compounds as the gain media for lasers is attractive thanks to the tunability of emission wavelengths resulting from their chemical modification, stability of forming excitons, and relatively simple and low-cost fabrication of small printable light sources. In addition, achieving the goal of light sources miniaturization and their integration into devices makes electrical pumping for laser emission essential.

To this day, the proper functioning of such devices remains elusive since there are several unresolved issues. These include emission losses, low charge mobility that has to be overcome, and an unambiguous effect of pumping current densities that must be, on the one hand, low due to the risk of device deterioration but, on the other hand, high enough to stimulate the lasing emission. [1] The specified issues can be tackled in Organic Light Emitting Transistors that consist of functioning layers for current injection, charge transport, light emission, optical feedback, etc.

Yet in addition to the mentioned challenges, the light-emitting layer itself must meet several conditions to operate as a reliable laser gain medium. In particular, one should minimize losses of electrical energy that have not led to the emissive excited states of organic compounds as well as losses of emission of the layer caused by triplet states formation or emission reabsorption. [2] Above all, the selected organic compounds must exhibit stimulated emission (SE).

Therefore, at this stage, before introducing electricity as a pumping source, we aim to understand if the selected compounds demonstrate SE, under which conditions SE appears in a thin film, and how efficient SE is relative to the losses through reabsorption by excited singlet and triplet states, polarons etc.

Now, we focus on evaluating the potential of various organic compounds as compartments of the light-emissive layer. For that purpose, we have investigated several promising compounds in both solutions and thin films, employing time-resolved spectroscopies so far. An example of the pronounced SE in a film of specific organic compound **1** is demonstrated in the Figure 1. The incorporation of this promising compound into electrically pumped structures is underway.

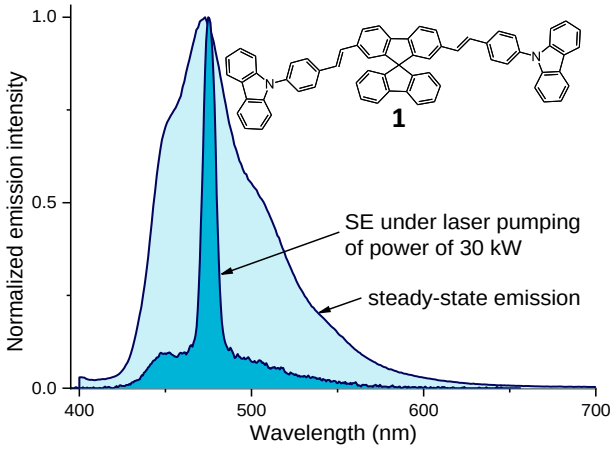

Figure 1. 1 film emissions under 355 nm light excitation

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References

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