

Mode dynamics in solid-state organic micro-lasers

Stefan Bittner), Joseph Zyss, Mélanie Lebental (LPQM), Eugène Bogomolny (LPTMS), Christian Ulysse, Dominique Decanini (C2N, Marcoussis).

The objective of this project was to investigate the dynamics of dye-doped polymer-based microlasers. At the beginning of the project, the cavities were quasi two-dimensional (thickness $0.6\ \mu\text{m}$ and $100\ \mu\text{m}$ in plane). Stefan Bittner worked on square-shaped cavities. The semi-classical description of this non-integrable system was in very good agreement with numerical simulations and experiments [1]. It was then used to dynamically control the emission, under operation [2]. These methods were also applied to various triangles. The features were evidenced to depend on the geometry of the triangles [3]. In parallel, the fabrication and the characterization setup were extended to three-dimensional resonators (see Figure). We then developed a 3D goniometer [4] and investigated cuboids with a square-shaped cross section [5].

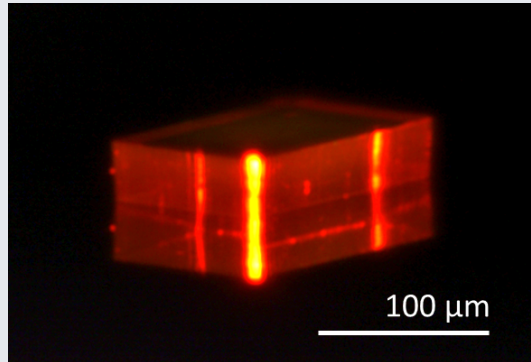


Image in real colors of a cuboid microlaser under optical pumping. The green pump beam is not visible. The laser emission is yellow-red. The image of the cavity is duplicated by reflection on the substrate.

The PALM founding was half of the post-doctoral grant for two years. This project ended in October 2014. But the collaboration with Stefan Bittner is still fruitful and leads to papers which are published after the end of the project.

[1] S. Bittner, C. Lafargue, I. Gozhyk, N. Djellali, L. Milliet, D. T. Hickox-Young, C. Ulysse, D. Bouche, R. Dubertrand, E. Bogomolny, J. Zyss, and M. Lebental, *Origin of emission from square-shaped organic microlasers*, *Europhysics Letters*, vol. 113, 54002 (2016)

[2] S. Bittner, A. Loirette-Pelous, C. Lafargue, I. Gozhyk, C. Ulysse, B. Dietz, J. Zyss, M. Lebental, *Dynamical control of square microlaser emission via symmetry classes*, arxiv:1707.09560 (2017)

[3] C. Lafargue, M. Lebental, A. Grigis, C. Ulysse, I. Gozhyk, N. Djellali, J. Zyss, and S. Bittner, *Localized lasing modes of triangular organic microlasers*, *Physical Review E*, vol. 90, 052922 (2014)

[4] C. Lafargue, S. Bittner, S. Lozenko, J. Lautru, J. Zyss, C. Ulysse, C. Cluzel, M. Lebental, *Three-dimensional emission from organic Fabry-Perot microlasers*, *Applied Physics Letters*, vol. 102, 251120 (2013)

[5] W. V. Chen, N. Sobeshchuk, C. Lafargue, E. Mansfield, J. Yom, L. Johnstone, J.M. Hales, S. Bittner, S. Charpignon, D. Ulbricht, J. Lautru, I. Denisyuk, J. Zyss, J. Perry, M. Lebental, *Three-dimensional organic microlasers with low lasing thresholds fabricated by multiphoton and UV lithography*, *Optics Express*, vol. 22, p. 12316 (2014)

Résultats obtenus dans le cadre du projet MoDynO financé par le thème 2 du LabEx PALM et porté par Mélanie Lebental (LPQM)