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Low-cost integrated photonics and non-linear optics using 3D printing on polymers associated to bipyrimidine for the creation of a broadband spectrum

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In recent years, 3D printing technologies have enabled the rapid production of a wide variety of parts and elements/pieces. At the same time, various micro-phonic components are still manufactured in cleanrooms, which generates significant operating costs. The idea behind this prospective work is to study the possible manufacture of optical fibers and giant tapers in integrated photonics using (bio)-polymers materials and 3D printers (G-code programming). After studying the extrusion speeds and temperatures of wires through a 150 μm diameter nozzle, it was possible to optimize the manufacture of tapers allowing high spatial compression of light (by a factor of several tens, that is compression mm to several tens μm). Optical propagation losses could be determined by a cut-back method used in integrated optics [1]. The future application plans to do in nonlinear optics, creation of broad spectra coupled or not to resonances (concepts of micro-resonators), it would be interesting to incorporate, for example, the bipyrimidine compound [2] into these organic materials during fiber weaving. With this goal in mind, a series of bipyrimidine based chromophores are prepared with alkoxy styryl groups and connected with electron accepting 2,2'-bipyrimidine cores which has been rooted for designing the pyrimidine that contain conjugated systems with complementary colors for luminescence and two photon absorption properties. Therefore, it is to be mixed with polymers and used in optoelectronic applications such as sensors and micro-resonators in the field of integrated photonics, as well as to create a broadband emission spectrum for nonlinear optics.

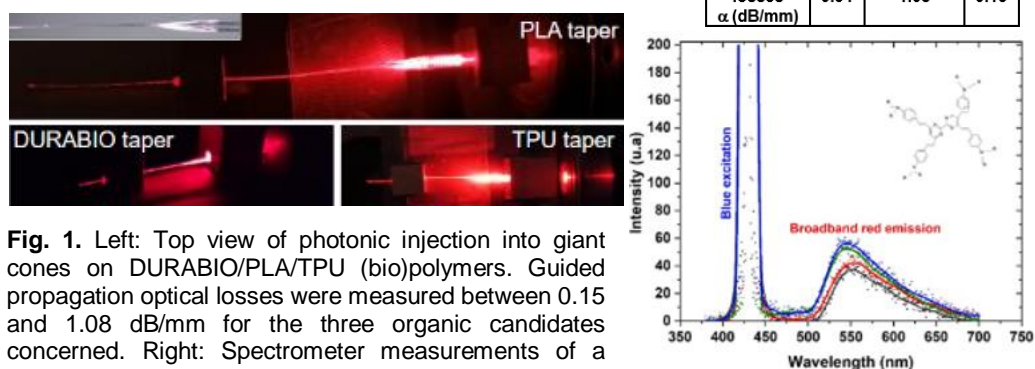


Fig. 1. Left: Top view of photonic injection into giant cones on DURABIO/PLA/TPU (bio)polymers. Guided propagation optical losses were measured between 0.15 and 1.08 dB/mm for the three organic candidates concerned. Right: Spectrometer measurements of a broad spectrum emitted/created in the red by bipyrimidine powder excited by a sharp blue laser.

[1] M. Ghandour, C. Sudja, A. Sureshkumar, S. Pernon, N. Coulon, J.B. Le Cam, S. Moindjie, F. Artzner, A. Moréac, C. Levallois, G. Loas, J. Vaillant, H. Akdaş-Kiliç, J. Gastebois, H. Cormerais, B. Bêche, 3D printing of micron-scale tapered optical fibers made from bio-based organic materials: multiple physical and optical characterizations, towards a new form of integrated photonic, *SPIE Edition - The international Society for Optical Engineering*, **2026**, to be published, 1-8

[2] H. Akdas-Kilic, M. Godfroy, J. Fillaut, B. Donnio, B. Heinrich, P. Kędziora, J. Malval, "Mesogenic, luminescence, and nonlinear optical properties of new bipyrimidine-based octupoles", *The Journal of Physical Chemistry C*, **2015**, 119, 3690-3710.