# MAP-fis Essay Proposal, 2016-2017

(*please write in English*)

## Supervisor

***Name:*** Paulo Vicente da Silva Marques

***e-mail:*** psmarque@fc.up.pt

## Title

Fabrication of Optofluidic Systems by Femtosecond Laser Micromachining

## Area

(*Materials, Optics, Condensed Theory, High Energy Theory,....*);

Optics

## Summary of Proposal

Lab-on-a-chip systems have acquired significant interest over the past years due to the possibility of integrating multiple functions in a compact portable device. Accordingly, femtosecond laser micromachining as emerged as a capable technique that relies on a non-linear absorption process to locally alter the material (glass, crystals) properties. Particularly, when applied to fused silica it enables production of optical layers and microfluidic systems. Moreover, its capacity to integrate them monolithically and to fabricate three-dimensional devices has a significant potential in this field.

However, integration of optical and microfluidic systems is not a straightforward task, requiring a clear understanding of the fabrication process to optimize light coupling/interaction. Correspondingly, this proposal aims at studying the fundamentals of fs-laser writing and possible applications for optical sensing, in particular when combining in a single device optical waveguides, microfluidic channels and polymeric structures constructed by multiphoton photopolymerization.

## References

(t*o allow students first look at topic*)

K. Sugioka, and Y. Cheng, “Femtosecond Laser 3D Micromachining for Microfluidic and

Optofluidic Applications”, 1st ed. Berlin, Germany: Springer, 2014.

R. Osellame, G. Cerullo, and R. Ramponi, “Femtosecond Laser Micromachining: Photonic and Microfluidic Devices in Transparent Materials”, 1st ed. Berlin, Germany: Springer, 2012.

N. Bellini, K. C. Vishnubhatla, F. Bragheri, L. Ferrara, P. Minzioni, R. Ramponi, I. Cristiani, and R. Osellame, “Femtosecond laser fabricated monolithic chip for optical trapping and stretching of single cells”, Optics Express, vol. 18, no. 5, pp. 4679-4688, 2010.

A. Crespi, Y. Gu, B. Ngamsom, H. J. W. M. Hoekstra, C. Dongre, M. Pollnau, R. Ramponi, H. H. van den Vlekkert, P. Watts, G. Cerullo, and R. Osellame, “Three-dimensional Mach-Zehnder interferometer in a microfluidic chip for spatially-resolved label-free detection,” Lab on a Chip, vol. 10, no. 9, pp. 1167-1173, 2010.