



## Masters Internship in Photonics/Optics

### Modelling and fabrication of nano-structured surfaces for security documents

#### Context and description

Oberthur Fiduciaire is one of the world's leading private security printers specialised in the design and production of banknotes and related optical security features ("holograms"). The company is working in collaboration with IMT Atlantique which is a graduate (« Grande Ecole ») engineering school in information technology. Their collaboration aims to design and fabricate metasurfaces as strong security elements to fight against counterfeiting. Metasurfaces (composed of nano-structures) are capable of manipulating light with unprecedented flexibility acting on phase, polarization, amplitude and dispersion. Based on the technique of multi-photon polymerisation (« 3D nanoprinter ») developed in the IMT laboratory<sup>1,2</sup>, the manufacturing of sub-wavelength metasurfaces has been made possible, opening up many perspectives for optical security elements. In particular, Oberthur Fiduciaire is looking for impressive visual effects that are very easy to authenticate such as vivid structural colors<sup>3,4</sup> or depth and movement effects thanks to metalenses<sup>5,6</sup>. The aim of the internship is to model such metasurfaces, predicting the light behaviour thanks to simulations, then to fabricate the nano-structures to validate the model. The resulting software will help select the parameters of metasurfaces in order to achieve specific impressive visual effects.

#### Internship tasks/objectives

To fulfil the tasks set by Oberthur Fiduciaire and IMT Atlantique in this project, the selected candidate's roles will include:

- digitally model different kinds of metasurface for security document applications
- simulate the perceived visual effect resulting from the action of the metasurface on illuminating light
- fabricate resulting nanostructures to validate/iterate the model
- disseminate the scientific results (patents, conferences, publications, ...).

The candidate should have a strong theoretical and practical background in photonics and will be expected to contribute his/her own innovative ideas to develop new metasurfaces. The work will be performed in the IMT Atlantique laboratory in a team with optics department researchers (Profs, PhD students ...) but also in close relationship with the recruiting company Oberthur Fiduciaire.

If the internship is successful, the subject will be continued into a 3-year PhD project (CIFRE scholarship).

#### Candidate profile

- Masters or engineering student and with a solid grounding in and practical experience of photonics
- Experience of digital modelling (Matlab, Python, C ...) of photonic/physical processes
- Practical experience of characterisation techniques: optical/electronic microscopy, spectroscopy...
- Cleanroom and photolithography experience would be an advantage
- Taste and aptitude for laboratory experimentation (fabrication) and practical applications.
- Ability to work and write scientific reports and articles in English. French is not required initially.

#### Practical details

Start date: Feb/March 2024

Duration: 6 months (then possible PhD thesis)

Location: IMT Atlantique, Brest

Financial conditions: internship grant of ~600€ net/month

Applications close: 31st December 2023

Please send candidatures to:

Prof. Kevin Heggarty (IMT A.) [kevin.heggarty@imt-atlantique.fr](mailto:kevin.heggarty@imt-atlantique.fr)

Dr. Marie Scholkopf (Oberthur F.) [m.scholkopf@fcf.com](mailto:m.scholkopf@fcf.com)

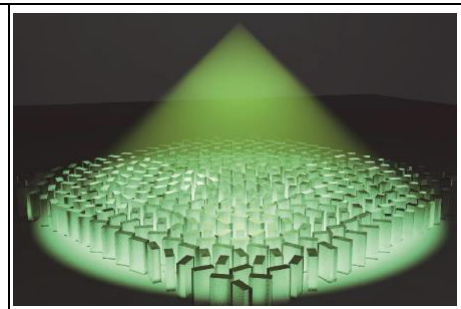


Figure from Ref 7

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