PhD thesis proposal

Materials and nanostructuring processes for personalized security features

3-year PhD position

Funding: Company HID Global CID through a public-private partnership
Application open from April 2019
Starting date: between September and October 2019
The student will be located at: Laboratoire Hubert Curien UMR CNRS 5516
18 Rue du professeur Benoit Lauras
42 000 SAINT-ETIENNE, FRANCE
And at: IM2NP, UMR CNRS 7334
Domaine Universitaire de Saint Jérôme,
13397 MARSEILLE Cedex 20, FRANCE
In collaboration with: HID Global CID, Suresnes, France

Subject

In a context where government agencies develop enhanced security policies and technologies to track and protect the correct identity of every person, the company HID Global CID and the Laboratory Hubert Curien have been developing for 3 years new solutions for the security of ID documents. These solutions are based on the development of innovative materials, laser processing and nanostructuring technologies. Here, they associate to IM2NP to go further in their research and development of security features of level 1, which can allow authenticating a document at one glance.

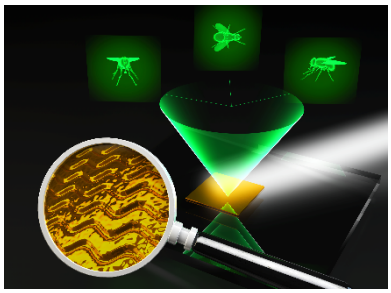

Figure 1 : Hidden images appear by illuminating the supports with white light under high incidence angle and are revealed thanks to self-organized diffractive micropatterns created by the laser.

The team at Laboratory Hubert Curien has developed expertise in the elaboration of nanocomposite thin films by sol-gel process, in the micro-nano-structuring of materials by lasers and in the use of plasmonic thin films for visual effects. It especially unveiled laser-induced self-organization processes [Des14, Liu17], which led to propose a technology for printing hidden images on flexible transparent supports (Fig. 1)[Sha19]. The group at IM2NP has developed technologies to pattern metal oxide sol-gel materials with controlled optical constants through soft-nano imprint lithography [Bot18]. These metasurfaces have been optimized to cover various photonic functions such as structural colors, filters, or absorbers [Che19] [Bot17].

In the framework of this PhD project, the student will contribute to develop new nanostructured materials using sol-gel chemistry, nanoimprint lithography and laser processes on and inside plastic supports. He or she will have to optimize the material (chemical composition, structure and optical properties), and elaboration process taking into consideration the constraints related to the support and structuring techniques. He or she will also be involved in the implementation of structuring processes such as nanoimprint lithography and laser processes that will

have to combine at different levels of the elaboration protocol. The main goal will be to develop several features exhibiting totally original visual features that could be used for level 1 visual security.

The PhD student will be hired by University of Saint-Etienne and will work partly in Marseille at IM2NP. He or she will also work in close collaboration with HID Global CID. Travel and housing expenses during professional trips will be fully paid by the Universities.

References

[Des14] N. Destouches, N. Crespo-Monteiro, G. Vitrant, Y. Lefkir, S. Reynaud, T. Epicier, Y. Liu, F. Vocanson, F. Pigeon, "Self-organized growth of metallic nanoparticles in a thin film under homogeneous and continuous-wave light excitation", J. Mater. Chem. C, 2, 6256-6263 (2014)

[Liu17] Liu, J. Siegel, M. Garcia-Lechuga, T. Epicier, Y. Lefkir, S. Reynaud, M. Bugnet, F. Vocanson, J. Solis, G. Vitrant, N. Destouches, "3D self-organization in nanocomposite layered systems by ultrafast laser pulses", ACS Nano, 11 (5), 5031–5040 (2017)

[Sha19] N. Sharma, M. Vangheluwe, F. Vocanson, A. Cazier, M. Bugnet, S. Reynaud, A. Vermeulin, N. Destouches, "Laser-driven plasmonic gratings for multiple image hiding", Materials Horizons, DOI: 10.1039/C9MH00017H (2019)

[Bot18] T. Bottein, O.Dalstein, M. Putero, A. Cattoni, M. Faustini, M. Abbarchi, D. Grosso. Environment-controlled sol–gel soft-NIL processing for optimized titania, alumina, silica and yttria-zirconia imprinting at sub-micron dimensions, Nanoscale (2018), DOI: 10.1039/C7NR07491C.

[Che19] S. Checcucci, T. Bottein, M. Gurioli, L. Favre, D. Grosso and M. Abbarchi, "Multifunctional Metasurfaces Based on Direct Nanoimprint of Titania Sol–Gel Coatings » Advanced Optical Materials, 1801406 (2019).

[Bot17] T. Bottein, T. Wood, T. David, J.B. Claude, L. Favre, I. Berbezier, A. Ronda, M. Abbarchi and D. Grosso. "Black" Titania coatings composed of sol-gel Imprinted Mie resonators arrays. Adv. Funct. Mater. 27, article N° 1604924, (2017), DOI: 10.1002/adfm.201604924.

Candidate profile

The PhD candidate must have an advanced level in chemistry and material science with knowledge in physics and optics. He or she must show a strong motivation to carry out experimental work in material elaboration, micro-nanostructuring and laser processing. An experience in sol-gel chemistry and with plasmonic nanomaterials would be greatly appreciated. The abilities to take initiatives and to work with autonomy are compulsory to properly carry out this thesis. The candidate must be open-minded and curious, scrupulous and able to develop new experimental protocols.

Application

Please send the following documents to the two contact persons:

- ✓ **your CV with a possible list of publications and conferences,**
- ✓ **a motivation letter,**
- ✓ **your Bachelor and Master transcripts,**
- ✓ **references or recommendation letters.**

Interesting candidates will be interviewed by Skype for a first discussion during the 15 days following their application.

Contacts:

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Prof. David Grosso, IM2NP, david.grosso@univ-amu.fr