Universität Stuttgart physik fakultät 8

SCoPE
STUTTGART RESEARCH CENTER OF PHOTONIC ENGINEERING

Nathalie Destouches

Univ. Lyon, UJM-Saint-Etienne, CNRS

Laser processing of plasmonic metasurfaces for secured color printing

Wednesday, November 13, 2019, 13 p.m.
Seminar Room 4th Physics Institute
Pfaffenwaldring 57, room 4.319

Hiding several images in a single printing, which appear selectively under different angles of observation, is of great interest for applications to security, data storage or design. Several techniques have been developed for this purpose, based on holography, moiré methods, multiple laser image (MLI) systems or on the use of dichroic plasmonic colors [1-2]. A technology combining plasmonic metasurfaces and laser scanning processes is presented here. It provides a simple implementation for printing multiplexed images with high flexibility and a micrometric spatial resolution. It is based on the shaping by femtosecond or nanosecond laser pulses of metallic Ag nanoparticles within thin TiO_2 films and the triggering of self-organization mechanisms that lead to very regular periodic patterns controlled at the sub-wavelength scale. Here, we present the main physico-chemical mechanisms [3] that contribute to the shaping of plasmonic films at the nanometer and micrometer scales and we show how such a laser technology allows engineering dichroic colors [4] and reinventing multiple laser image printing with self-organized gratings [5] and image multiplexing with up to three different images printed in the same set of pixels.

[1] E. Heydari, J. R. Sperling, S. L. Neale and A. W. Clark, *Plasmonic Color Filters as Dual-State Nanopixels for High-Density Microimage Encoding*, Adv. Funct. Mater., 2017, 27, 1–6.
[2] X. M. Goh, Y. Zheng, S. J. Tan, L. Zhang, K. Kumar, C. W. Qiu and J. K. W. Yang, *Three-dimensional plasmonic stereoscopic prints in full colour*, Nat. Commun., 2014, 5, 5361.
[3] Z. 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, 2017, 11 (5), 5031–5040.
[4] N. Sharma, N. Destouches, C. Florian, R. Serna, J. Siegel, "Tailoring nanocomposite materials with ultrashort laser pulses for applications in photonics", Nanoscale, to be published
[5] 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, 2019, 6, 978.