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Directed Nanopatterning with Nonlinear Laser Lithography

ONUR TOKEL, OZGUN YAVUZ, EMRE ERGECEN, IHOR PAVLOV, GHAITH MAKEY, FATIH OMER ILDAY, Bilkent University — In spite of the successes of maskless optical nanopatterning methods, it remains extremely challenging to create any isotropic, periodic nanopattern. Further, available optical techniques lack the long-range coverage and high periodicity demanded by photonics and photovoltaics applications. Here, we provide a novel solution with Nonlinear Laser Lithography (NLL) approach [1]. Notably, we demonstrate that self-organized nanopatterns can be produced in all possible Bravais lattice types. Further, we show that carefully chosen defects or structued noise can direct NLL symmetries. Exploitation of directed self-organizatio to select or guide to predetermined symmetries is a new capability. Predictive capabilities for such far-from-equilibrium, dissipative systems is very limited due to a lack of experimental systems with predictive models. Here we also present a completely predictive model, and experimentally confirm that the emergence of motifs can be regulated by engineering defects, while the polarization of the ultrafast laser prescribes lattice symmetry, which in turn reinforces translational invariance. Thus, NLL enables a novel, maskless nanofabrication approach, where laser-induced nanopatterns can be rapidly created in any lattice symmetry.
[1] Nature Photonics,7,897(2013)

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