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**Highly Stable Nanolattice Structures using Nonlinear Laser Lithography** OZGUN YAVUZ, ONUR TOKEL, Department of Physics, Bilkent University, 06800 Ankara, Turkey, EMRE ERGECEN, Department of Physics, Massachusetts Institute of Technology, Cambridge Massachusetts MA 02139, IHOR PAVLOV, GHAITH MAKEY, FATIH OMER ILDAY, Department of Physics, Bilkent University, 06800 Ankara, Turkey — Periodic nanopatterning is crucial for multiple technologies, including photovoltaics and display technologies. Conventional optical lithography techniques require complex masks, while e-beam and ion-beam lithography require expensive equipment. With the Nonlinear Laser Lithography (NLL) technique, we had recently shown that various surfaces can be covered with extremely periodic nanopatterns with ultrafast lasers through a single-step, maskless and inexpensive method. Here, we expand NLL nanopatterns to flexible materials, and also present a fully predictive model for the formation of NLL nanostructures as confirmed with experiments. In NLL, a nonlocal positive feedback mechanism (dipole scattering) competes with a rate limiting negative feedback mechanism. Here, we show that judicious use of the laser polarisation can constrain the lattice symmetry, while the nonlinearities regulate periodicity. We experimentally demonstrate that in addition to one dimensional periodic stripes, two dimensional lattices can be produced on surfaces. In particular, hexagonal and square lattices were produced, which are highly desired for display technologies. Notably, with this approach, we can tile flexible substrates, which can find applications in next generation display technologies.

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