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**3D Functional Elements Deep Inside Silicon with Nonlinear Laser Lithography** ONUR TOKEL, AHMET TURNALI, Bilkent University, EMRE ERGECEN, Massachusetts Institute of Technology, IHOR PAVLOV, FATIH OMER ILDAY, Bilkent University — Functional optical and electrical elements fabricated on silicon (Si) constitute fundamental building blocks of electronics and Si-photonics. However, since the highly successful established lithography are geared towards surface processing, elements embedded inside Si simply do not exist. Here, we present a novel direct-laser writing method for positioning buried functional elements inside Si wafers. This new phenomenon is distinct from previous work, in that the surface of Si is not modified. By exploiting nonlinear interactions of a focused laser, permanent refractive index changes are induced inside Si. The imprinted index contrast is then used to demonstrate a plethora of functional elements and capabilities embedded inside Si[1]. In particular, we demonstrate the first functional optical element inside Si, the first information-storage capability inside Si, creation of high-resolution subsurface holograms, buried multilevel structures, and complex 3D architectures in Si, none of which is currently possible with other methods. This new approach complements available techniques by taking advantage of the real estate under Si, and therefore can pave the way for creating entirely new multilevel devices through electronic-photonic integration. [1]Tokel,O.,arxiv.org/abs/1409.28

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