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Local Probes of Strain Texture and Individual Atomic Dopant Sites in Monolayer MoS_2 ALEX H. FRAGAPANE, ALEX W. CONTRYMAN, HONG LI, Stanford University, XIAOFENG QIAN, SINA MOEINI ARDAKANI, MIT, YONGJI GONG, XINGLI WANG, Rice University, JEFFREY M. WEISSE, CHI HWAN LEE, JIHENG ZHAO, Stanford University, PULICKEL M. AJAYAN, Rice University, JU LI, MIT, XIAOLIN ZHENG, HARI C. MANOHARAN, Stanford University — The 2D semiconductor MoS_2 is an optically active material uniquely responsive to local perturbations. As an atomically thin membrane with exceptional strength, it can embed wide band gap variations overlapping the visible light spectrum when subjected to biaxial strain, where the modified electronic potential emanating from point-induced tensile strain perturbations mimics the Coulomb potential in a mesoscopic atom. We have realized this "artificial atom" concept via monolayer nanoindentation, and demonstrate that a synthetic superlattice of these building blocks forms an optoelectronic crystal capable of broadband light absorption and efficient funneling of photogenerated excitons to points of maximum strain at the artificial-atom nuclei. We also investigate the effects of individual atomic dopant sites through STM/STS, and visualize the atomic-scale local band structure changes. The modification of 2D semiconductors through methods such as strain texturing and doping connects to applications in next generation optoelectronics and photovoltaics.

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