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| **Title:** | **Bandgap Tuned WS2 Thin-Film Photodetector by Strain Gradient in van der Waals Effective Homojunctions** | | |
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| **Abstract:** |  |
| Van der Waals (vdW) heterostructures (or heterojunctions) are formed by stacking two different 2D materials (e.g., graphene, h-BN, or transition metal dichalcogenides) across vdW gaps. In a type-II heterojunction, 2D semiconductors are aligned with staggered bandgaps, which can effectively separate electron and hole carriers, and enable promising high-performance photovoltaics and photodetectors. Herein, an effective vdW-homojunction is reported, formed by one 2D material (2H-WS2) with vdW gap engineering leading to different electronic structures and type-II junction formation. WS2 films are synthesized by W metal deposition and controlled sulfurization method leading to a nonuniform vdW gap strain in the film. The vdW strain gradients in multilayer WS2 films are confirmed by transmission electron microscopy analysis, and the modeling by density functional theory shows an effective type-II homojunction formation via modulated bandgaps by the vdW gap strains. The superior performance of a broadband photodetector application is confirmed by photoluminescence and photocurrent experiments. | |