Type-Converted n-doping of Tungsten diselenide through thermal and optical activation

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Transition metal dichalcogenides (TMDs) receive greatattention as next generation flexible nanoelectronics materials due to itssuperior electrical, optical properties. TMDs have high immunity to the shortchannel effect (SCE) due to scalability down to monolayer based on their vander Waals epitaxial structure without surface dangling bond and native oxides. Thus,WSe_2-based thin film transistors (TFTs) have high field-effectmobility (~100$cm^2V^{-1}s^{-1}$). However, WSe_2can normally be fabricated as p-type TFTs due to the fermi-level pinning effectat metal-semiconductor contact. It causes difficulties for widening researchrelated on TMDs electrical and optical applications. In recently reported work,WSe_2 n-FET was fabricated by applying a potassium doping. Another WSe_2 n-FET made by tetracyanoquinodimethane (F_4TCNQ)n-doping technique was reported. However, optical behavior is notinvestigated in many researches related to type-converted FET devices.

In this work, we demonstrate type-converted doping method for WSe_2 TFT devices with the assistance of phosphorus silicate glass (PSG) and laser activation. This work is achieved through 2 step process consisting of, first, surface dopant control through dopant out-diffusion by annealing PSG at 900°C, second, optical activation. Activated surface dopant causes strong dipoles between bottom layer of WSe_2 and top layer of PSG. It can make type-converted WSe_2 TFT due to strong dipoles induce more electrons at bottom layer of WSe_2 flake.