The surface oxidation effect on photocurrent in $WSe_{1.95}Te_{0.05}$ nanosheets

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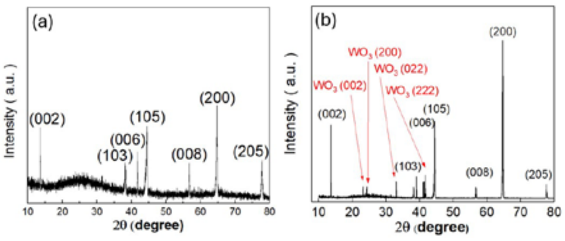
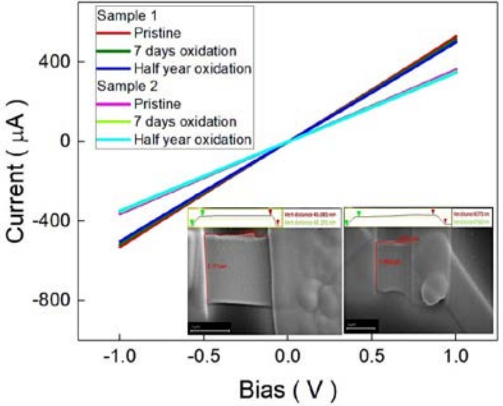
ABSTRACT

- Surface oxidation effect on photocurrent responsibility was detected in WSe1.95Te0.05 nanosheets, and the photocurrent response depends on the light wavelength.
- It is enhanced at the wavelength of 405 nm, while no change at the wavelength of 532 nm and suppressed at the wavelength of 808 nm.
  The IPCE is expected to increase at 405 nm wavelength, unchanged at 532 nm wavelength and decrease at 808 nm wavelength.
- The trending of photocurrent change after half years exposure is corresponding to the absorbance changing from pristine $WSe_{1.95}Te_{0.05}$ to the WO3. The wavelength dependent photocurrent responsibility is understood as the wavelength dependent incident photon-to-current efficiency of WO3 that is from the surface oxidized $WSe_{1.95}Te_{0.05}$.

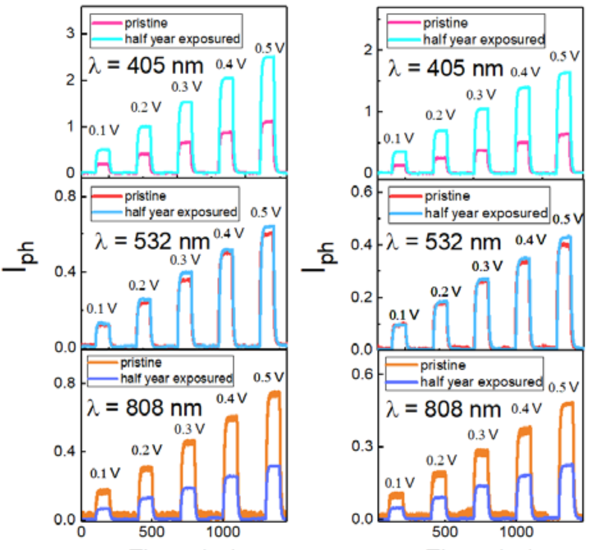
RESULTS



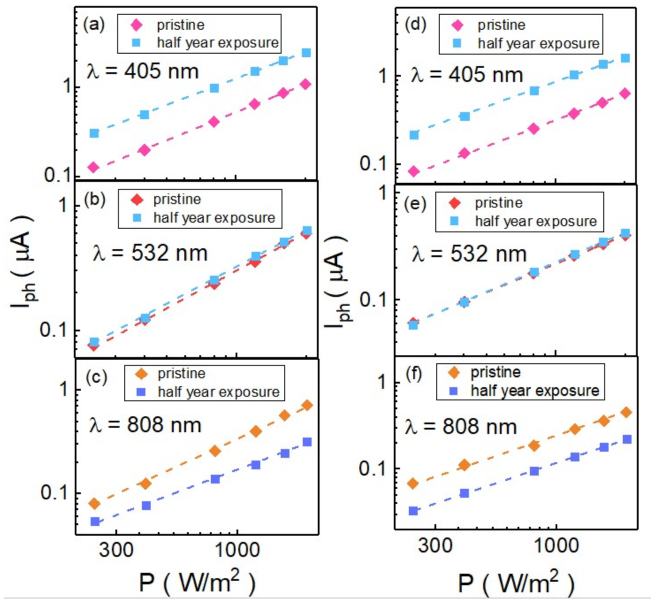
- (a) The XRD of single crystal $WSe_{1.95}Te_{0.05}$. The sharp XRD peaks indicated the highly crystallized structure.
- (b) The XRD of single crystal $WSe_{1.95}Te_{0.05}$ after oxidation. The new peak at 23, 24, 33 and 43 degree represent the oxidized $WSe_{1.95}Te_{0.05}$ - WO_3



- The I-V curves of two sample. The linearly curves show no contact resistance of the samples.
- The bottom-right inset show the SEM geometric image of sample 1 and sample 2. The device thickness were determined by AFM, which show in upper area of insect. The thickness of two sample is 45 nm and 46 nm.



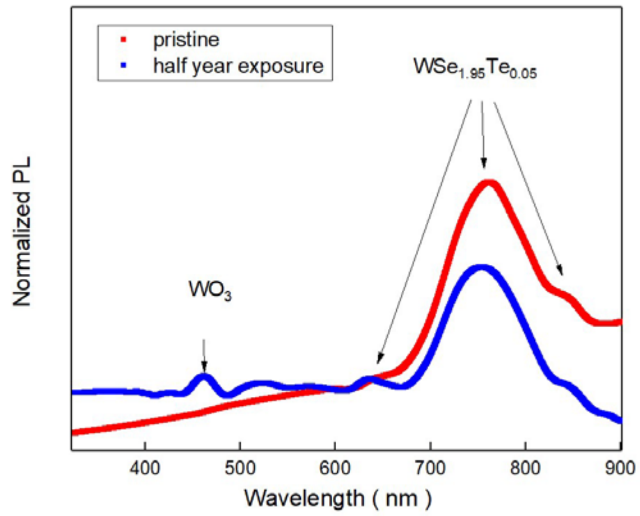
- The photocurrent of different applied voltages for samples of as-prepared and after half-year exposure. It is enhanced at the wavelength of 405 nm, while no change at the wavelength of 532 nm and suppressed at the wavelength of 808 nm.



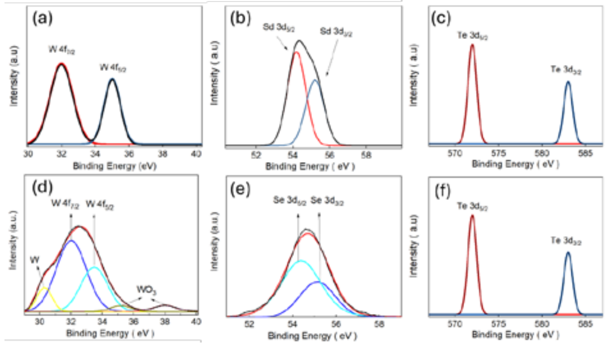
- The photocurrent as a function of light power intensity for pristine and half-year exposed $WSe_{1.95}Te_{0.05}$ nanosheets at different wavelengths for two samples.

- Table I, List of responsibility and β of S1 and S2 under different wavelength. The applied bias is 0.5 V

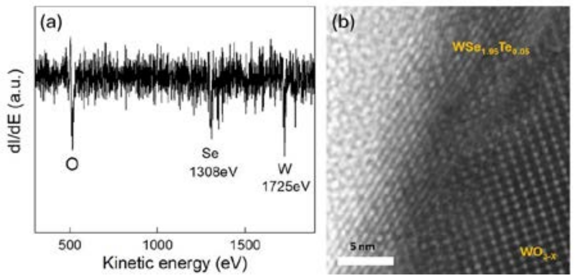
Sample	Wavelength (nm)	Responsivity (AW^{-1})	β
S1, pristine	405	88	0.98
S1, half year exposed	405	269	1.02
S1, pristine	532	69	0.98
S1, half year exposed	532	64	1.00
S1, pristine	808	77	1.04
S1, half year exposed	808	34	0.89
S2, pristine	405	174	0.96
S2, half year exposed	405	442	0.95
S2, pristine	532	115	0.93
S2, half year exposed	532	108	0.89
S2, pristine	808	128	0.88
S2, half year exposed	808	60	0.94



- The photoluminescence (PL) of the pristine and half year-exposure. The detected peak at wavelength 455 nm origin from the oxidation vacancy of $WSe_{1.95}Te_{0.05}$, which is WO_3.



- (a)(e) The XPS spectrum of W4f. The binding energy peak located at 31.9 eV, 35 eV and 37.4 eV corresponding to the W $4f_{7/2}$, W $4f_{5/2}$ of $WSe_{1.95}Te_{0.05}$ and WO_3.
- (b)(e) The XPS spectrum of Se 3d. The binding energy peak located at 54.2 eV and 55.2 eV corresponding to the Se $3d_{5/2}$, Se $3d_{3/2}$.
- (c)(f) The XPS spectrum of Te 3d. The binding energy peak located at 572.0 and 583.1 eV corresponding to the Te $3d_{5/2}$, Te $3d_{3/2}$.



- (a)The auger electron spectroscopy, the peak position of W shifts from 1730 to 1725 eV. This imples the absorption and oxidation on the surface.
- (b) The TEM images in the side view. It exhibits both $WSe_{1.95}Te_{0.05}$ and WO_3.

CONCLUSIONS

- Surface oxidation effect on photocurrent responsibility was detected in $WSe_{1.95}Te_{0.05}$ nanosheets.
- It is enhanced at the wavelength of 405 nm, while no change at the wavelength of 532 nm and suppressed at the wavelength of 808 nm.
- The trending of photocurrent change after half year exposure is corresponding to the absorbance changing from pristine $WSe_{1.95}Te_{0.05}$ to the WO_3. The wavelength dependent photocurrent responsibility is understood as the wavelength dependent incident photon-to-current efficiency of WO_3 that is from the surface oxidized $WSe_{1.95}Te_{0.05}$.