НАУЧНАЯ СЕКЦИЯ «МАТЕРИАЛЫ И ХИМИЧЕСКИЕ ПРОДУКТЫ. МАШИНОСТРОЕНИЕ И МЕТАЛЛУРГИЯ»

AN UV-VIS-IR LIGHT DETECTION FILM BASED ON PHOTOELECTRIC EFFECT

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Abstract: *in this study, $Al_{1-x}In_xN$ films with different band gap energy (E_g) were deposited by radio-frequency (RF) magnetron sputtering. The E_g of films shows a red-shift from 2.95 to 2.20 eV. We investigated the photo-response behaviors of the as-grown films under the illumination of LED with a center wavelength of 365, 532, and 650 nm, respectively. The wavelength of the detected light can be determined by the increment of photocurrent. The rise time and fall time of the photocurrent are 3.6 ± 0.1 s and 6.5 ± 1 s, respectively, which is four times faster than the typical MoS_2 photodetectors.*
Keywords: *AlInN; Magnetron sputtering; band gap; photodetector.*

The $Al_{1-x}In_xN$ films with different E_g were prepared on Si substrate by RF magnetron sputtering. The electrical and optoelectrical characteristics were analyzed with a semiconductor parameter analyzer (Keithley 4200-SCS) and an optical system, including a UV light-emitting diode (LED) with a center wavelength of 365 nm, a green LED of 532 nm, a red LED of 650 nm, and an automatic shutter.

Fig. 1 shows the photocurrent of as-grown $Al_{1-x}In_xN$ films as a function of time under the alternative dark and illumination conditions at different LED wavelengths. The wavelength of the detected light can be determined by the increment of photocurrent. In addition, the corresponding rise times (t_{rise}), taken from dark current (I_{dark}) to photocurrent (I_{light}), and the fall time (t_{fall}), taken from I_{light} to I_{dark}, are shown in Figs. 2(b), 2(c), and 2(d), respectively. The average t_{rise} and t_{fall} are 3.6 ± 0.1 s and 6.5 ± 1 s, respectively, which is four times faster than the typical MoS_2 photodetectors[1] (t_{rise} = 12.9 s, t_{fall} = 28.8 s), as shown in Fig. 3. Besides, the $Al_{1-x}In_xN$ films in this study do not require a stress liner, which reduces the costs significantly.

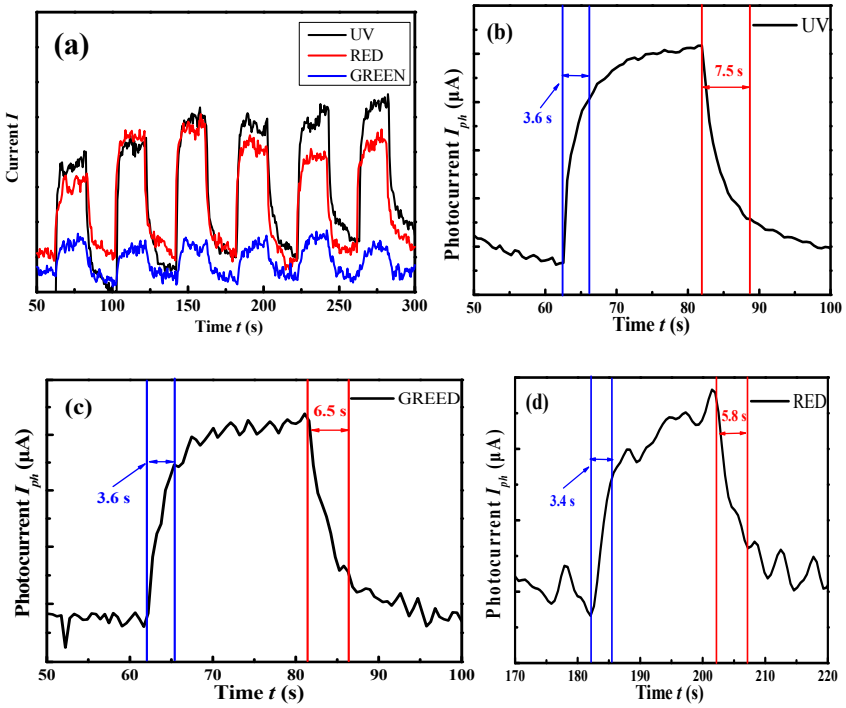

Fig. 1 – (*a*) Photocurrent as a function of time under the alternative dark and illumination conditions at different LED wavelength (365, 532, 650 nm). The corresponding rise time and fall time under (*b*) UV, (*c*) GREEN, and (*d*) RED LED, respectively

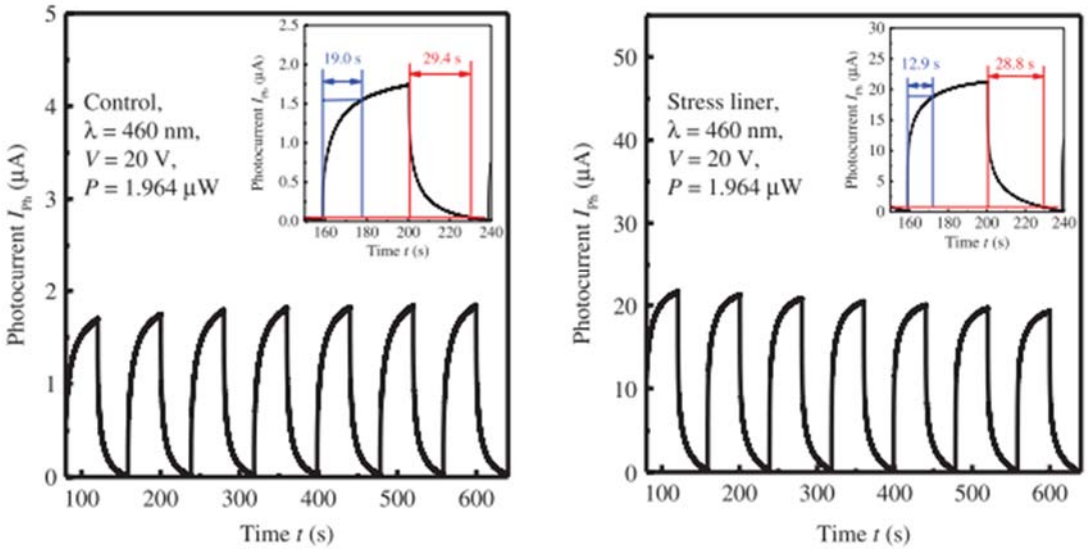

Fig. 2 – The photocurrent of typical MoS_2 photodetectors with and without stress liner. The corresponding rise time and fall time are shown in the inset.

In summary, the photoswitching behaviors of $Al_{1-x}In_xN$ films with tunable E_g exhibit good reliability and reproducibility. It is found that the wavelength of the detected light can be determined by the increment of photocurrent. The average t_{rise} and t_{fall} are 3.6 ± 0.1 s and 6.5 ± 1 s, respectively.