Ultra-broad spectral photoresponse in $FePS_3$ air-stable devices

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Abstract

The family of transition metal phosphorus trichalcogenides, with general formula MPX_3 (with M a transition metal, P phosphorus and X = S or Se chalcogens), is gaining relevance as they offer competitive advantages when compared to other semiconducting and/or magnetic two-dimensional materials [1]. The photoresponse of $FePS_3$ has recently been addressed in the context of photodetection applications limited only to the ultraviolet spectral range [2]. Here, we push forward the state of the art, presenting a detailed spectral distribution of the electrical photoresponse of $FePS_3$ nanosheets, finding that $FePS_3$ is a narrow gap p-type semiconductor with a high enough conductivity to enable the electrical detection of optical excitations in a broad wavelength range. In addition, we observe a significant stability of $FePS_3$ nanosheets when exposed to air and/or light, higher than for other magnetic materials, which facilitates device preparation, characterization and, eventually, application. With views to the future, this work manifests the relevance of $FePS_3$ not only for ultra-broad photodetection but as a key material for investigations on magneto-optics and opto-spintronics at the 2D limit among a wide spectral range.

REFERENCES

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FIGURES

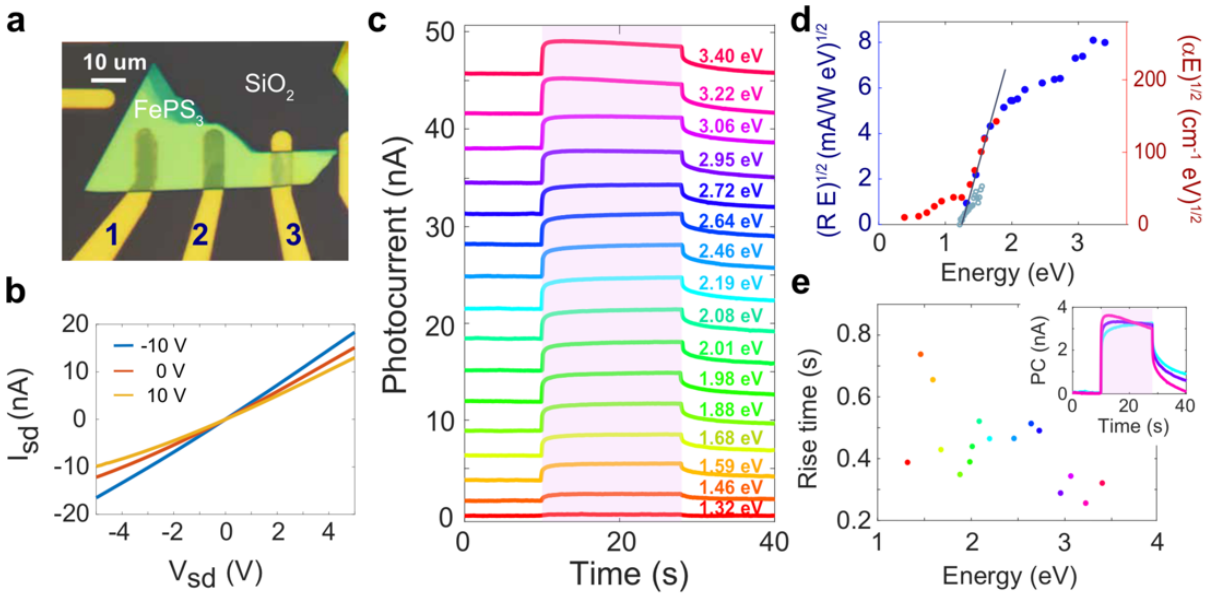

Figure 1: (a) Optical image of a $FePS_3$ device onto a SiO_2/Si substrate with pre-patterned Ti/Au contacts (*1-3*). (b) *I-V* plot at different applied gate voltages (V_g = -10, 0 10 V). (c) Photocurrent versus time at different optical excitation energies. (d) Our experimental Tauc plot (blue and grey dots) and absorbance measurements reported by Brec, et al. (red dots) [3]. (e) Rise time of the $FePS_3$ photodetector as a function of the incident photon energy. The inset shows the trend of the photocurrent with time as a function of energy.