UV photoresponse and magnetic control of single-layer titania nanosheets

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Two-dimensional materials have attracted great interests in the past decade from various fields. We have recently focused on titania (titanium oxide) nanosheets chemically exfoliated from layered titanate crystals [1]. In our earlier work, we found a drastic change in the conductivity of an individual single-layer titania nanosheet under humid conditions [2]. In the present work, we will report photoresponse and magnetic control of titania nanosheets.

We have demonstrated a phtoresponse of fabricated two-terminal devices with a single-layer titania nanosheet under periodic illuminations of ultra violet (UV) light. As shown in Fig.1, we observed a clear on/off switching with a short rise/fall time (< 0.2 sec). The photocurrent under UV illuminations strongly depends on environmental gas molecules. The reduction of the photocurrent even under inert nitrogen gas atmospheres implies that collisions of gas molecules affects annihilations of electron-hole pairs on the surface-sensitive two-dimensional nanosheet [3].

We have also investigated magnetic behaviors of Mn-doped titania nanosheets. Single-layer titania nanosheets with magnetic impurities deposited on a Si substrate were measured by X-ray magnetic circular dichroism (XMCD). The XMCD spectra as shown in Fig.2 revealed a weak ferromagnetic order of the nanosheets even at room temperature. Fe overlayers on the nanosheets induced antiferromagnetic couplings between the nanosheets and the Fe overlayers [4].

References

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[2] A. Tanaka *et al*., Appl. Phys. Lett. **104** (2014) 163106.
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[4] N. Saitou *et al*., submitted.

Figures

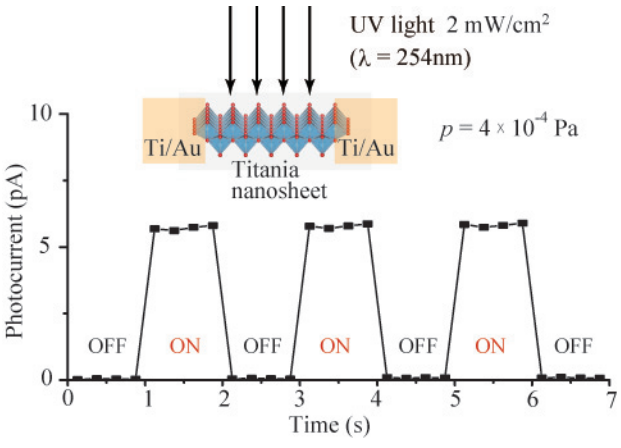

Figure 1: Photocurrent under periodic pulsed UV illuminations at bias voltage of 1.0 V.

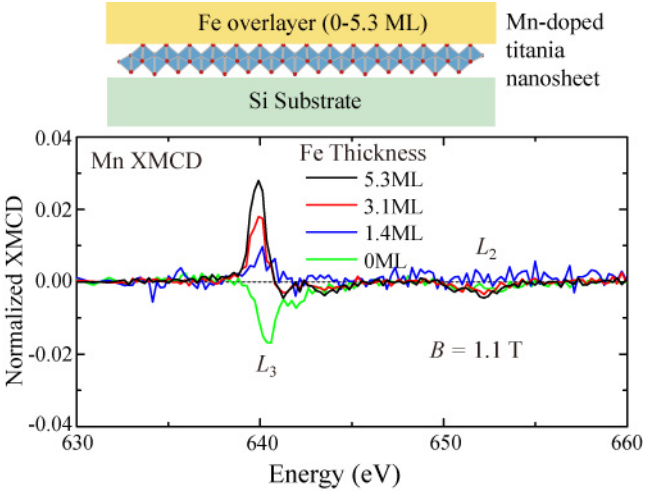

Figure 2: Normalized Mn $L_{2,3}$ XMCD spectra for different thicknesses of Fe overlayers.