Visualizing photothermal anisotropy in black phosphorus with total internal reflection pump-probe technique

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Abstract

Black phosphorus (BP) has recently attracted enormous attention due to its moderate bandgap, high carrier mobility and striking in-plane anisotropy.[1, 2] Among them because of the high-extinction coefficient, photothermal conversion efficiency and no observable toxicity in various biological tissues, there is a promising potential for BP as a photothermal therapy.[3] Herein, based on the polarization-dependent absorption of BP under total internal reflection, we developed a new pump-probe technique for photothermal measurement. The photothermal anisotropy of BP was experimentally obtained for the first time. The different crystal orientation of BP can be distinguished accurately by relationship between polarization of pump light and photothermal signal. And we also find that the BP not only exists as a heat source leading to change of refractive index in photothermal media, but also could detect the minor photothermal signal as a sensing layer. Therefore, the surface of BP and the varieties of media has the significant impact on photothermal signal, which not only provide an accurate way to measure crystal orientation but also expand the practical applications of biosensors.

References

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2. Guo, Q.; Pospischil, A.; Bhuiyan, M.; Jiang, H.; Tian, H.; Farmer, D. B.; Deng, B.; Li, C.; Han, S. J.; Wang, H. *Nano letters* (2016), 16, (7), 4648.
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Figures

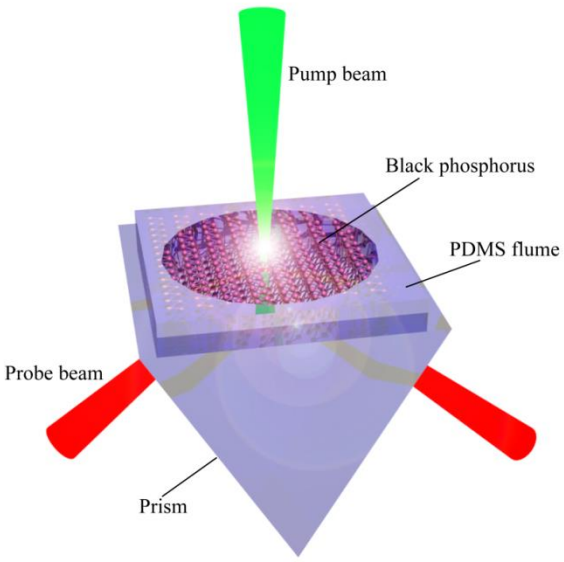

Figure 1: There is the schematic of the essential part, which are a coverslip / the PDMS channel / BP samples / quartz on the prism.

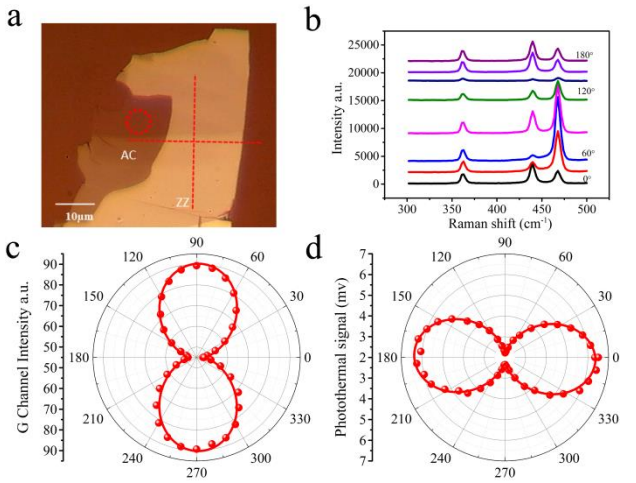

Figure 4. Identification of crystal orientation using polarization angle-dependent photothermal detection. **a,** Optical image of few-layer BP on ZF-13 glass plates. **b,** The change in polarized Raman spectra as a function of the orientation angle of BP sample. The spectra are recorded every 30º from 0º to 180 ° by rotating the samples with relative preserved intensities. **c,** The variation in optical contrast of BP sample in G channel as a function of the rotation angle. **d,** Polar plots of the photothermal signal as a function of the polarization angle in pump beam.