Optical modulators with two-dimensional layered materials

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Light modulation is an essential operation in photonics and optoelectronics. The recent demonstration that two-dimensional layered materials could modulate various light properties (e.g., wavelength, amplitude, phase, and polarization) with superior performance has stimulated intense research and significant advances [1-7], paving the way for realistic photonic and optoelectronic applications [1-12]. I will discuss the state-of-the-art of optical modulators based on two-dimensional layered materials including graphene [4-5,10], transition metal dichalcogenides [8] and black phosphorus (Fig.1a) [9]. I will present recent advances employing hybrid structures, such as two-dimensional heterostructures [1], plasmonic structures (Fig.1b) [12], and silicon/fibre integrated structures [5,8-12]. I will also take a look at future perspectives of optical modulation technologies with two-dimensional layered materials.

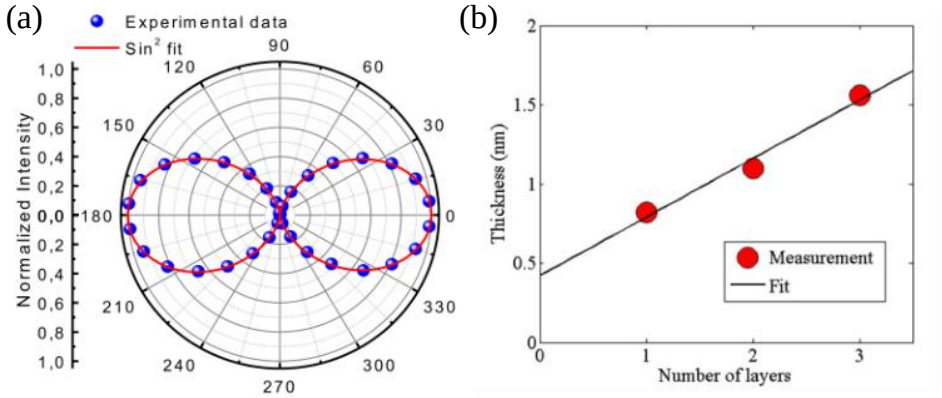

Figure 1. a. Linear polarization output of a black phosphorus modulated all-fiber laser [9]; b. Thickness measurement of graphene with surface plasmon resonance [12].

References

[1] Z. Sun *et al.*, Nat. Photonics, **15**, 227 (2016).
[2] F. Bonaccorso *et al.*, Nat. Photonics, **4**, 611 (2010).
[3] A. Ferrari, *et al.*, Nanoscale, **7**, 4598-4810 (2015).
[4] Z. Sun, *et al.*, ACS Nano **4**, 803 (2010).
[5] T. Hasan, *et al.*, Adv. Mater. **21**, 3874 (2009).
[6] Z. Luo, et.al. Nanoscale **8**, 1066 (2016).
[7] X. Yang et.al., Adv. Mater. DOI:10.1002/adma.201505765 (2016).
[8] F. Bonaccorso, Z. Sun, Opt. Mater. Exp. **4**, 63 (2014).
[9] D. Li, *et al.*, Sci. Rep. **5**, 15899 (2015).
[10] A. Martinez, Z. Sun, Nat. Photonics **7**, 842 (2013).
[11] Z. Sun et al., Physica E, **44**, 1082 (2012).
[12] H. Jussia *et al.*, Optica **3**, 151 (2016).