Tunability of optical absorption of MoS₂ by electrical gating and its application in a hybrid modulator

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Abstract

It was recently established that optical constants of 2D monolayers, in contrast to many bulk semiconducting materials such as Si, Ge, GaAs, could vary significantly with electrical field[1-2]. Here we investigated the electric field effect on optical properties of a monolayer of molybdenum disulphide (MoS₂). This field effect is utilised to achieve ~10% visible light modulation for a hybrid electro-optical resonant modulator based on MoS₂. A suggested hybrid nanostructure consists of a CMOS compatible Si₃N₄ dielectric layer sandwiched between a thin gold film and a MoS₂ monolayer which enables a selective enhancement of polarised electro-absorption in a narrow window of angles of incidence and a narrow wavelength range near MoS₂ exciton transition energies. The possibility to modulate visible light with 2D materials and the robust nature of light modulation by MoS₂ could be useful for creation of reliable ultra-compact electro-optical hybrid visible-light modulators.

References


Figures

Figure 1: Schematic illustration of the Au/Si₃N₄/MoS₂ modulator structure.

Figure 2: Change in s-polarised reflectance in the Au/Si₃N₄/MoS₂ hybrid modulator for different gating voltages with an incident angle of 80 degree.