Indium selenide light-emitting diodes

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Van der Waals stacking enables engineering of complex electronic and optoelectronic devices with single-atomic-layer precision [1]. Combining broad range of properties of various 2D crystals this approach has already been used to design a plethora of multilayered structures, among others, light-emitting diodes (LED) made of conducting (e.g. graphene), semiconducting (transition metal dichalcogenides) and insulating layers (hexagonal boron nitride (BN)) materials [2].

Recently, a lot of attention has been focused on a new emerging 2D semiconductor, indium selenide, with an unusual band structure exhibiting a "Mexican hat" shaped valence band [3]. Depending on the number of layers, its photoluminescence (PL) ranges from 1.2 eV to 1.9 eV, making InSe a perfect choice for optical applications. In this work we have used few layer thick InSe crystals to fabricate complex LED devices and measured their optical properties from 7 K to the room temperature. We observe bright electroluminescence (EL) and photoluminescence in the whole temperature range. While EL has very little temperature dependence, the PL drastically changes, switching from 1.25 eV at high to 1.5 eV in the cryogenic range.

References

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[3] D. A. Bandurin, A. Tyurnina et al., Nature Nanotechnology, vol. 12, no. 3 (2017) pp. 223–227

Figures

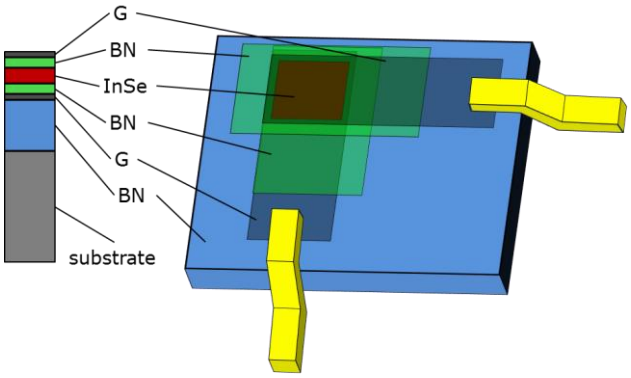

Figure 1: Structure of an LED. The BN layers are 2 to 5 layers each and the InSe is 4 and 8 layers thick.