Formamidinium lead bromide perovskite as visible-light detector

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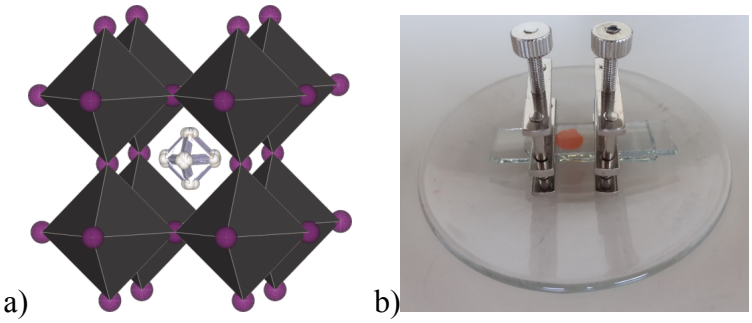
Organic-inorganic halide perovskites have become a major research topic in the past ten years due to a variety of semiconducting applications, namely solar cells, luminescence, photocatalysis and photodetectors [1]. The current work deals in particular with the use of $FAPbBr_3$ ($FA = (NH_2)_2CH$) as a visible-light detector [2]. The polycrystalline compound was prepared by fusion of the precursor compounds $PbBr_2$ and FABr in solid state under vacuum. It was then pressed in the form of a pellet and two transparent fluorine-doped tin oxide (FTO) glasses were attached on both sides as electrodes. This air-stable, red-color compound exhibits a direct band gap of 2.15 eV and it has been proposed as a single-crystal detector for both for visible and X-ray photons [3,4].



a) b)

Figure 1: a) The crystal structure of the pseudo-cubic $FAPbBr_3$ with disordered C and N atoms. Hydrogen atoms are omitted. b) Photodetector device made of a $FAPbBr_3$ pellet sandwiched between two conducting FTO glasses.

We investigate the use of formamidinium lead bromide as a photodetector under various illuminating conditions, spanning the visible spectral range. The obtained I-V curves and spectral responsivity show a high sensitivity of the electrical resistance of the detector on the incident photon wavelength, in the range 550 – 600 nm. Photovoltage from the device under pulsed laser excitation at 405 nm wavelength allows for the measurement of the rise and fall time of the detector for various light pulse frequencies, in the range 1 Hz – 1 KHz. Overall, this work proposes polycrystalline $FAPbBr_3$ as a low-cost and readily prepared visible-light detector for optoelectronic applications.

References

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