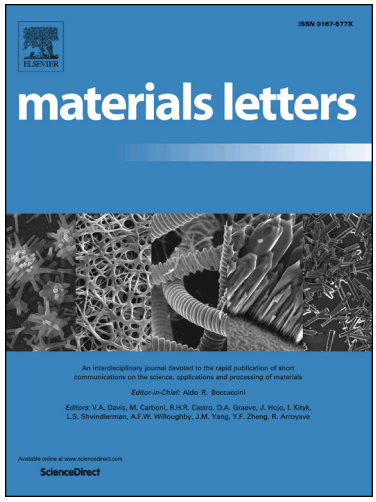


# Deep inherent sensitization of lead selenide material via an effective oxygen ion preparation method

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# Deep inherent sensitization of lead selenide material via an effective oxygen ion preparation method

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The lead selenide material sensitization via $O^+$ beam implantation at 50 keV is demonstrated. The structural and morphological characterizations suggest that the resulting material is of polycrystalline solids with the grain size of ~700 nm. Compared with the conventional oxygen diffused material, the ion prepared polycrystalline material exhibits higher optical absorption, carrier mobility and photo-responsivity. The optical characterizations reveal that it is structurally well-ordered with the optical bandgap of ~0.22 eV and Urbach energy as small as 34.6 meV at room temperature. It is revealed that the high responsivity may be attributed to its effective optical absorption in mid-infrared regime and high carrier mobility, induced by the ion beam modifications. This technique may provide an effective method to synthesize the lead chalcogenide polycrystalline materials and relevant nanomaterials for high optical and optoelectronic properties.

**Keywords:** Ion beam technology; Physical vapour deposition; Thin films; Polycrystalline lead selenide; Sensitization

## 1. Introduction

The lead selenide (PbSe) is a promising narrow bandgap semiconductor material ($E_g$=0.27 eV at 300K), and has been widely used for its attractive optical, optoelectronic, and thermoelectric properties in many fields such as infrared optoelectronics [1,2], solar cells [3,4], thermoelectric materials [5,6], optical nonlinearity [7,8], etc. Recently, the PbSe polycrystalline material synthesized by vapor phase deposition (VPD) and sensitization techniques exhibits high photo-sensitivity in mid-infrared regime (2-5 μm) and good integration compatibility with CMOS electronics, and draws wide attention from the low cost and room