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Improving the performance of amorphous selenium photodetectors by alloying for indirect X-ray imaging

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Amorphous selenium (a-Se) is a well-studied photoconductor utilized in both direct and indirect X-ray detection, with applications in medical, industrial, materials, and high-energy imaging; recent studies also highlight its potential for particle detection with noble elements. Amorphous Se exhibits many ideal properties for photodetection, with excellent conversion efficiency from the vacuum ultraviolet (VUV) through blue wavelengths at reasonable fields (40 V/μm), low leakage currents, and low-cost large-area fabrication capabilities. Its ability to achieve impact ionization at low fields (<70 V/μm) offers potential for low-photon detection with high signal. However, a-Se suffers from low hole and electron mobilities, and its bandgap of 2.1 eV limits its applications in green to near infrared (NIR) detection, which is important for high-yield, high-resolution scintillators.

Studies of alloying a-Se with Group IV and VI elements have long been performed to improve the material properties. However, until recently, it was thought that these alloys instead lead to detrimental impacts in transport and, therefore, detector performance. In this work, we will review our studies of alloying a-Se with Ge and Te, demonstrating that improvements can be found when conditions are optimized, such as alloy content, applied field, and device architecture. We will discuss how the physics of the material plays a role in the device performance and outline paths towards even greater improvements and the potential for alloyed a-Se in future detector applications.

Early Career

Yes

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