Synthesis and investigation of $ReSe_2$ Thin Films Derived from Magnetron Sputtered Re and ReO_x

Kevon Kadiwala, Luize Dipane, Eriks Dipans, Arturs Bundulis, Martins Zubkins, Andrejs Ogurcovs, Jevgenijs Gabrusenoks, Dmitry Bocharov, Edgars Butanovs, Boris Polyakov

Institute of Solid State Physics, University of Latvia

The remarkable potential of two-dimensional (2D) anisotropic rhenium diselenide ($ReSe_2$) in electronics and optoelectronics has spurred significant interest in its synthesis. However, achieving controlled growth of high-quality $ReSe_2$ thin films on a wafer scale remains a challenging endeavor. In this study, we present a novel approach for synthesizing $ReSe_2$ thin films with thicknesses down to tens of nanometers using magnetron sputtering and chemical vapor transport (CVT) in a two-step method. We comprehensively characterized the surface morphology and chemical structure of the resulting $ReSe_2$ films utilizing scanning electron microscopy (SEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and Raman spectroscopy. Additionally, we evaluated the electrical, optical and nonlinear optical characteristics of the films and examined their photoconductive properties under 532nm and 635nm wavelength illumination as well. This research not only facilitates accessible controlled-area growth of $ReSe_2$ for both fundamental investigations and practical applications but also offers valuable insights into the chemical synthesis of other anisotropic 2D materials.