Patrick M Vora et al., J Material Sci Eng 2017, 6:7 (Suppl)
DOI: 10.4172/2169-0022-C1-079

Structural and optical properties of the $MoTe_2$-WTe_2 alloy system

Patrick M Vora[1], Ryan Beams[2], Sean M Oliver[1], Sergiy Krylyuk[2,3], Arunima K Singh[2], Irina Kalish[2], Alina Bruma[2], Francesca Tavazza[2], Jaydeep Joshi[1], Iris Stone[1], Stephan J Stranick[2] and **Albert V Davydov[2]**

[1]George Mason University, USA

[2]National Institute of Standards and Technology, USA

[3]Theiss Research, USA

The structural polymorphism intrinsic to transition metal dichalcogenides provides exciting opportunities for engineering novel devices. Of special interest are memory technologies that rely upon controlled changes in crystal phase, collectively known as phase change memories (PCMs). $MoTe_2$ is ideal for PCMs as the ground state energy difference between the hexagonal (2H, semiconducting) and monoclinic (1T', metallic) phases is minimal. This energy difference can be further reduced by substituting W for Mo on the metal sublattice, thus improving PCM performance. Therefore, understanding the properties of $Mo_{1-x}WxTe_2$ alloys across the entire compositional range is vital for the technological application of these versatile materials. We combine Raman spectroscopy with aberration-corrected scanning transmission electron microscopy and x-ray diffraction to explore the $MoTe_2$-WTe_2 alloy system. The results of these studies enable the construction of the complete alloy phase diagram, while polarization-resolved Raman measurements provide phonon mode and symmetry assignments for all compositions. Temperature-dependent Raman measurements indicate a transition from 1T'-$MoTe_2$ to a distorted orthorhombic phase (T_d) below 250 K and facilitate identification of the harmonic contributions to the optical phonon modes in bulk $MoTe_2$ and $Mo_{1-x}W_xTe_2$ alloys. We also identify a Raman-forbidden $MoTe_2$ mode that is activated by compositional disorder and find that the main WTe_2 Raman peak is asymmetric for x<1. This asymmetry is well-fit by a phonon confinement model, which allows the determination of the phonon correlation length. Our work is foundational for future studies of $Mo_xW_{1-x}Te_2$ alloys and provides new insights into the impact of disorders in transition metal dichalcogenides.

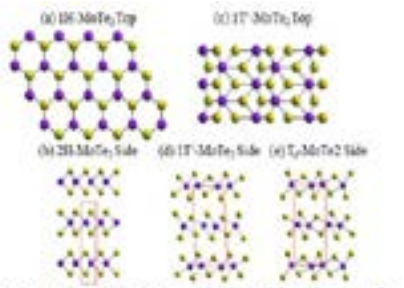

Figure.1: (a) Top and (b) side views of $MoTe_2$ in the 1H (monolayer) and 2H (bulk) structural phase. (c) top view of monolayer 1T' $MoTe_2$ (d,e) side view of bulk $MoTe_2$ in the 1T' and T_d structural phase.

Biography

Patrick M Vora has received a PhD in Physics from the University of Pennsylvania. Subsequently, he was a Postdoctoral Fellow at the University of Pennsylvania and later at the US Naval Research Laboratory as a part of the National Research Council's Research Associateship Program. He was named an Assistant Professor at George Mason University in 2014 where he has established a research group that focuses on two-dimensional materials. He has published 22 papers in reputed journals.

pvora@gmu.edu

Notes: