Cd_3As_2/II-VI heterostructures on (111) GaAs

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Cd_3As_2 is an exciting material system. As a Dirac semimetal, it is a 3-D analogue of graphene [1] and provides access to a variety of interesting physics, ranging from massless Dirac fermions to topological superconductivity. It also exhibits very high electron mobility and large phonon-phonon scattering, which are ideal for a number of energy-related applications. While interest in Cd_3As_2 has recently risen, most work to date has been confined to bulk single crystals rather than thin films. Epitaxial growth on foreign substrates would allow strain and heterostructure engineering as well as permit careful studies of doping and confinement. Molecular beam epitaxy of Cd_3As_2 has been carried out primarily on GaSb (111) layers grown on GaAs (111) substrates (-3.5% mismatch) [2] and directly on CdTe(111)B substrates (2.3% mismatch) [3]. Both take advantage of the preferred (112) growth surface of Cd_3As_2. However, no efforts to further improve lattice matching have been reported to date.

Building off of previous work of improved GaAs(001)/ZnSe(001) interfaces [4], growth of II-VI compounds on (111) GaAs is explored both as a route toward improved growth surfaces as well as integration into heterostructures. Cd_3As_2 epilayers were first grown on CdTe/ZnTe buffers on GaAs (111) substrates. The resulting Cd_3As_2 layers grown on these structures showed comparable carrier/mobility relationships and improved RMS roughness to materials in previous reports, as shown in fig. 1. Alloyed $Cd_xZn_{1-x}Te$ (111) layers were then developed to explore lattice-matched growth as well as systematic strain effects (fig. 2). Effects of light stimulation during growth will also be discussed.

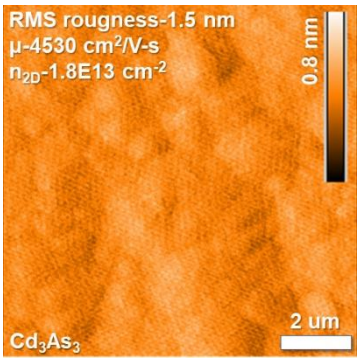

Fig. 1 10x10 um AFM image of Cd_3As_2 grown on CdTe (111)

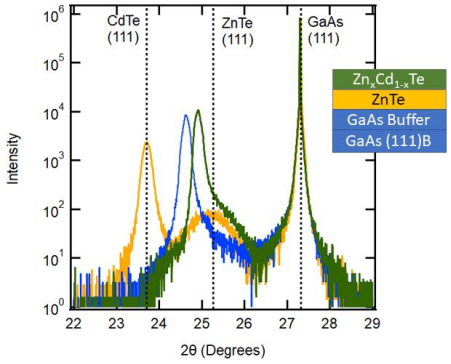

Fig. 2 2θ-ω X-ray diffraction scan of $Cd_xZn_{1-x}Te$ (111) structures grown on GaAs (111)

[1] Z.K. Liu, *et al., Nature Materials*, **13**, 677 (2014)
[2] T. Schumann *et al.,* APL Mater. **4**, 126110 (2016)
[3] M. Goyal *et al.* APL Mater. **6**, 026105 (2018)
[4] K. Park, K. Alberi. *Scientific Reports.* **7**, 8516 (2017)

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