MBE GROWTH OF PbTe ON Si (100) SUBSTRATES

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The growth of PbTe directly on Si (100) by Molecular Beam Epitaxy (MBE) is reported for the first time, and the results of the characterization of the epitaxial IV-VI layers by Reflection High Energy Electron Diffraction (RHEED), X-ray High Resolution Difractometry and Scanning Electron Microscopy (SEM) are discussed. Such a heterojunction between silicon and a narrow gap semiconductor would provide higher quantum efficiencies for infrared detection in the MWIR (3-5μm) band at room temperature [1], and the fabrication of a first n-PbTe/p-Si (100) detector using Hot Wall Epitaxy (HWE) technique was recently reported [2]. Our preliminary results show that, due to the large lattice mismatch (~19%) between silicon and lead telluride, the growth starts by the deposition of unstrained polycrystalline IV-VI epilayers, followed by a continuous transition to a mosaic structure composed of macroscopic PbTe (100) regions, either aligned or rotated by 45° relative to the original Si (100) surface orientation, and finally evolves to a smooth monocrystalline film, as evidenced *in situ* by the RHEED pattern evolution and *ex situ* by X-ray diffraction. The thickness of the polycrystal to mosaic surface transition layer, as well as that needed to reach smooth monocrystalline growth, critically depend on the substrate chemical and thermal treatments prior to growth. Depending on the treatment, either mosaic, rotated or non-rotated films are obtained at a same narrow growth temperature range. Smooth unreconstructed Si (100) surfaces were found to favor 45° rotated PbTe epitaxial films, whereas intentional thermal roughening of the substrate surface have lead to the predominance of non-rotated epitaxial PbTe films. In the future investigations with n-PbSnTe/p-Si (100) will be made in order to achieve devices with longer wavelength cut-off.

[1] G. Scott, D. E. Mercer and C. R. Helms. J. Vac. Sci. Technol. B 9 (3), pp. 1781-1784, May/Jun 1991.
[2] Yukum Yang, Wenmimg Li, Lei Yu, Xin Sun, Lixing Xu and Lantain Hou. Infrared Physics & Technology 38, pp. 9-12, 1997.