Growth and characterization of InP templates for Zn_2P_3 Absorbers

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Indium phosphide (InP) is a promising material that is utilized in various applications including solar cells, high speed communication systems, and photonic devices.[1] Additionally, as a substrate, it is widely used for the heteroepitaxy of high crystal quality semiconductor structures including GaAs, InAs, InSb and Zn_2P_3.[2]–[4] Especially for Zn_2P_3, InP substrates provides an excellent platform to obtain high crystallinity thin films. [5] Unfortunately the scarcity of In and the consequent high cost make InP poorly suited for earth-abundant devices. Being in demand both in science and in the industry, the monolithic integration of InP on silicon (Si) can enable new sustainable technologies.

Here, we show the growth of InP templates on Si substrates. To achieve this, we follow two techniques: liquid phase epitaxy (LPE) for the thin film growth and selective area epitaxy (SAE) for rectangular or disc shapes structures.[6] In both techniques, the growth consists of two steps: the initial deposition of liquid indium, and crystallization under phosphorous atmosphere. In LPE, the main challenge is to prevent indium from dewetting, which is known to happen above room temperature. We will tackle this by reducing the interface energy with the substrate. We will explore different materials by depositing a thin film (HfO_2, SiO_2, Cr, Pd, Ti, MoO_x, Pt) onto the Si (100) substrate via sputtering or evaporation before subsequent indium deposition. In the second technique, SAE, we first pattern nanoscale holes or stripes in a SiO_2 mask on the Si substrate, and then deposit liquid indium inside these patterns. We will share our results on the structure and composition of these samples obtained by various characterization techniques including Raman spectroscopy, electron (TEM and SEM) and atom force microscopy (AFM).

References

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