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Quantitative analysis of formation of oxide phases between SiO2 and InSb

Jaeyel Lee[1], Sehun Park[1,2], Jungsub Kim[1], Changjae Yang[1], Sujin Kim[1], Chulkyun Seok[1], Jinsub Park[1],and Euijoon Yoon[1,2]

[1]Department of Materials Science and Engineering, Seoul National University, Seoul, Korea, [2]Hybrid Materials Program (WCU), Department of Materials Science and Engineering, Seoul National University, Seoul, Korea

InSb has received great attentions as a promising candidate for the active layer of infrared photodetectors due to the well matched band gap for the detection of 3～5 μm infrared (IR) wavelength and high electron mobility (106 cm2/Vs at 77 K). In the fabrication of InSb photodetectors, passivation step to suppress dark currents is the key process and intensive studies were conducted to deposit the high quality passivation layers on InSb. Silicon dioxide (SiO2), silicon nitride (Si3N4) and anodic oxide have been investigated as passivation layers and SiO2 is generally used in recent InSb detector fabrication technology due to its better interface properties than other candidates. However, even in SiO2, indium oxide and antimony oxide formation at SiO2/InSb interface has been a critical problem and these oxides prevent the further improvement of interface properties. Also, the mechanisms for the formation of interface phases are still not fully understood.

In this study, we report the quantitative analysis of indium and antimony oxide formation at SiO2/InSb interface during plasma enhanced chemical vapor deposition at various growth temperatures and subsequent heat treatments. 30 nm-thick SiO2 layers were deposited on InSb at 120, 160, 200, 240 and 300^{o}C, and analyzed by X-ray photoelectron spectroscopy (XPS). With increasing deposition temperature, contents of indium and antimony oxides were also increased due to the enhanced diffusion. In addition, the sample deposited at 120^{o}C was annealed at 300^{o}C for 10 and 30 min and the contents of interfacial oxides were analyzed. Compared to as-grown samples, annealed sample showed lower contents of antimony oxide. This result implies that reduction process of antimony oxide to elemental antimony occurred at the interface more actively than as-grown samples.