Poly crystalline CdTe PN diode formed by Au and Al thermal doping

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The single crystalline CdTe, II-VI compound semiconductor, has been extensively studied to be used as X-ray detector. It needs to have its conduction carrier type determined whether the final device form is Schottky or PN diode, while the single crystal-based device is very hard to have its platform except itself; so it can hardly be fabricated on glass substrate. In this work, we report our effort on the poly crystalline CdTe PN junction device which used thermal evaporation for 100 μm-thick thick CdTe on glass substrate followed by respective thermal diffusion of Au and Al for p and n doping.

In order to deposit the large area poly crystalline CdTe onto glass substrate, we used various substrate temperatures in the range of 200~400 ^{o}C. Scanning electron microscopy and X-ray diffraction techniques were employed to investigate the substrate heating effect on CdTe crystalline quality. The CdTe layer, produced at 200 ^{o}C, clearly shows large grain size of ~5 μm in (111) orientation.

Many different types of metal electrodes were made by shadow mask on as-deposited CdTe to determine proper material for Ohmic and Schottky contact. The Au electrode, which has a deep work function of ~5.1 eV, made a good Ohmic contact with our p-type CdTe. On the other hand, the Al electrode can make Schottky contact with p-type CdTe due to its low work function. Our Al/CdTe/Au Schottky diodes (SDs) have a behavior with on/off ratio of ~10^2 at ± 10 V. When our Al/CdTe/Au SDs were then annealed by rapid thermal annealer (RTA) at 500 ^{o}C for few min in N_2 ambient, we observed that the leakage current was significantly reduced and on current became higher. We presume that the diffusion of Au and Al into CdTe made p^+-layer and n-layer near each electrode, respectively. Consequently, as-fabricated Al/CdTe/Au Schottky structure was transformed into the structure of Al/n-CdTe/p-CdTe/p^+-CdTe/Au (PIN). Our PIN diode shows a high on/off ratio of 10^4 at ±100 V, approaching to sensitive X-ray detectors. More and advanced details will be discussed in the meeting.