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Impact of annealing on Ti/4H-SiC Schottky barrier diode radiation detector performance for fusion alpha-particle diagnostics.

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Advanced fusion alpha-particle diagnostics in high D-T plasmas under high-fluences require efficient wide bandgap semiconductor detectors fabricated on 4H-SiC and Diamond materials. However, acquiring high-pure single crystalline diamond is difficult to fabricate large area detectors. This motivated to explore wide bandgap semiconductor 4H-SiC possessing high thermal conductivity suitable for harsh environments. This work includes electrical and spectral measurements of (Ti/Au)/4H-SiC Schottky barrier diode detectors when exposed to a Americium 241 alpha-source. Annealing procedure at 400 degrees centigrade for 5 minutes in nitrogen ambient was involved for few samples to observe the impact of annealing on spectral characteristics. Detector performance was quantitatively measured by determining parameters of energy resolution and charge collection efficiency. Improved alpha spectral characteristics upon annealing is attributed to the reduction of surface states at the interface which were plotted using forward current-voltage characteristics in this work. Detectors resolving the peaks in spectral characteristics highly depends on reverse leakage current of detectors which significantly reduced upon annealing is explained by finding out possible current conduction mechanisms.

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