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2P50 - Surface Passivation of GaAs Photoconductive Semiconductor Switches with Silicon Resin

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The surface defect states of GaAs substrate may cause surface flashover which results in the immature breakdown of the GaAs based photoconductive semiconductor switch (PCSS) devices. It is also expected that the shorter carrier life time and the high surface recombination velocity at the GaAs surface have impact on the performance of GaAs based PCSS devices.
In this study, the surface passivation effect on the performance of the lateral type 2-mm-gap GaAs PCSS is investigated. The 200-nm-thick SiNx grown by plasma enhanced chemical vapor deposition, and drop casted 1-cm-thick silicon resin have been considered as passivation materials on the GaAs PCSS surface. The operational characteristics of the GaAs PCSS were measured by using 1064-nm triggering laser exhibiting a nominal illumination optical energy of 135 μJ and an optical pulse width of 700 ps. It is shown that the surface passivation can increase the carrier lifetime and decrease the surface recombination velocity by reducing the density of the surface states at the GaAs surface. Thereby, the surface passivated PCSSs exhibit the higher pulse height and the longer pulse width compared to non-passivated devices. It is also noted that the surface passivation of the PCSS retards the onset of surface flashover of the PCSS leading to the higher voltage operation capability. The PCSS without surface passivation suffers from flashover at 2.4 kV and permanently fails after 200 times of operation due to the cracks formed on the surface. The PCSS passivated with silicon resin successfully operates without surface flashover up to the bias voltage of 4 kV. The output characteristics of the GaAs PCSS with and without passivation will be compared in terms of the onset voltage of surface flashover, the height and the width of the electrical pulses. This work was supported by KEPCO (R18XA06-79) and Korea Agency for Defense Development.

Author: Mr KIM, Yong-Pyo (Gwangju Institute of Science and Technology)

Co-authors: Mr CHOI, Pyeung Hwi (Gwangju Institute of Science and Technology); Dr KIM, Min-Seong (Agency for Defense Development); Mr RYU, Jiheon (Agency for Defense Development); Dr BAEK, Sung-hyun (Agency for Defense Development); Prof. HONG, Sung-Min (Gwangju Institute of Science and Technology); Prof. LEE, Sungbae (Gwangju Institute of Science and Technology); Prof. JANG, Jae-Hyung (Gwangju Institute of Science and Technology)

Presenter: Mr KIM, Yong-Pyo (Gwangju Institute of Science and Technology)

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