

## Investigation Trap Density in Oxide Layer of 4H-SiC MOS Capacitor During Long-Time Aging at 400°C Ambient

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**Introduction:** Recently, we have reported that TiN with high-temperature reliability and high-temperature melting point has become a potential candidate for metal gate of 4H-SiC MOSFET [1]. It is possible that, during the operation process in high-temperature environment, the diffusion and/or reaction of metal gate with oxide layer plays important role in the degradation of the electronic circuit based on 4H-SiC MOSFETs. In order to obtain the information of the diffusion and/or reaction of metal gate with the oxide layer when operating in high-temperature ambient, in this research, the distribution of trap density in the oxide layer of 4H-SiC MOS capacitor during the aging process at 400°C in N<sub>2</sub> ambient was investigated.

**Results and Discussions:** By applying the modified distributed circuit model, the near-interface traps at the 4H-SiC MOS interface was characterized [2]. Figure 1 shows the near interface trap density as a function of depth from SiO<sub>2</sub>/4H-SiC interface during the aging process at 400°C with Al (Fig. 1(a)) and TiN (Fig. 1(b)). The results showed that, during the aging process in N<sub>2</sub> ambient, the interface trap density decreased with aging time for both Al and TiN metal gate. However, after 100-hour aging, the decay constant of the capacitor with Al based is higher than that of TiN based. As a result, the near interface trap density of the capacitor with Al metal gate is much higher than that of the capacitor based on TiN metal. A much lower near interface trap density accounts for the high-temperature reliability of the integrated circuit based on 4H-SiC MOSFET with TiN metal gate. This result demonstrates that TiN is a promising candidate for harsh environment applications.

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[1] V. V. Cuong et al., The 13<sup>th</sup> European Conference on Silicon Carbide and Related Materials, Mo-IP-04 (2021).

[2] Xufang Zhang et al., Applied Physics Express **10**, 064101 (2017).

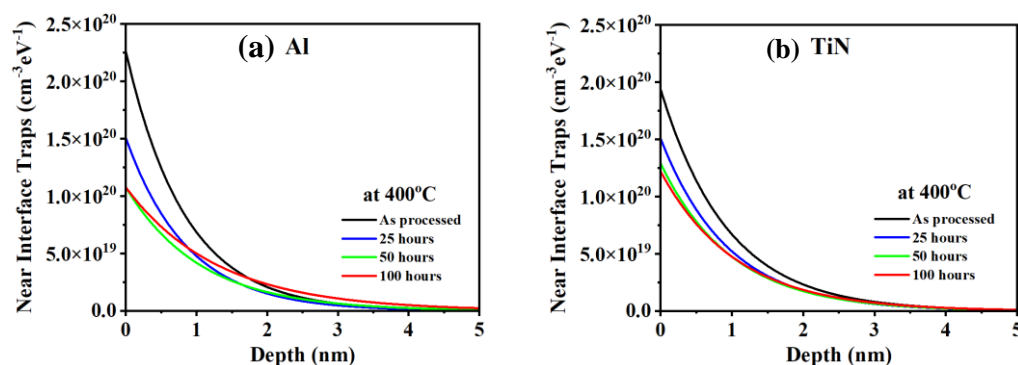


Fig. 1. Near interface trap density as a function of depth from SiO<sub>2</sub>/4H-SiC interface after different duration aging time at 400°C with (a) Al and (b) TiN metal gate.