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## A Comparative Study of Wet Etching and Contacts on $(\bar{2}01)$ and $(010)$ Oriented $\beta\text{-Ga}_2\text{O}_3$

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### ABSTRACT

We report on the effect of  $\beta\text{-Ga}_2\text{O}_3$  crystal orientation on wet etching and Ohmic contact formation. The photochemical etching rate in KOH solutions of  $(\bar{2}01)$  oriented, n-type bulk single crystals grown by the edge-defined film-fed growth method is ~3-4 times higher than for the  $(010)$  planes. The activation energy for etching was 0.498 eV and 0.424 eV for  $(\bar{2}01)$  and  $(010)$  orientations, respectively, suggesting the etching is reaction-limited with the same rate-limiting step. Ti (200 Å)/Au (1500 Å) metallization deposited on the two different orientations and annealed at 450 °C showed Ohmic current-voltage ( $I$ - $V$ ) behavior for  $(\bar{2}01)$  but rectifying characteristics for  $(010)$ . For  $(010)$   $\text{Ga}_2\text{O}_3$ , there exists 2 types of surfaces having Ga and O atomic densities of 0.58 and  $0.87 \times 10^{15} \text{ cm}^{-2}$ , respectively. By contrast, for  $(\bar{2}01)$   $\text{Ga}_2\text{O}_3$  surfaces, there exist 2 types of surface, with each type terminated with only Ga or O. If the surface is

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