High-*k* TiO_2 Films Deposition on Hydrogenated-diamond

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Diamond is a wide band gap semiconductor. It has some excellent basic physical properties, such as high breakdown field (~10 $MV \cdot cm^{-1}$), large hole mobility (3800 $cm^2 \cdot V^{-1} \cdot s^{-1}$), low dielectric constant (5.7), and high thermal conductively (22 $W \cdot cm^{-1} \cdot K^{-1}$). These properties make diamond suitable for the fabrication of high-power, high-frequency, and high-temperature electronic devices. Recently, diamond-based metal-insulator-semiconductor (MIS) capacitors and MIS field-effect transistors (MISFETs) have developed greatly. Most of them are fabricated on hydrogenated-diamond (H-diamond) epitaxial layers [1-3], which can accumulate holes on the surface with sheet hole density as large as ~10^{14} cm^{-2}.

In order to response the high hole density at a small electrical field, we have focused on the deposition of high-*k* insulators on the H-diamond [3]. The insulators were deposited by sputtering deposition (SD) and atomic layer deposition (ALD) techniques. The MIS capacitors showed low leakage current density (*J*) and low fixed and trapped charge densities. The MISFETs also operated well. However, the *k* values for the oxide insulators were not very high (<13). In this study, we will show our recent studies about the deposition of high-*k* TiO_2 films on the H-diamond substrates. The leakage current densities of SD-TiO_2 and ALD-TiO_2 films with ALD-Al_2O_3 as buffer layers on the H-diamond have been compared with other insulators [Fig. 1]. The capacitances and *k* values of them are higher and larger than 0.82 $\mu F \cdot cm^{-2}$ and 25, respectively. In the presentation, we will also show the electrical properties of TiO_2/Al_2O_3/H-diamond MISFETs and logic inverters.

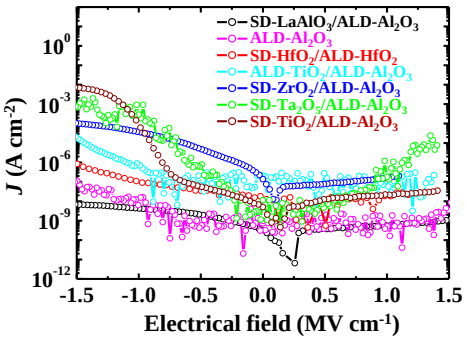

Figure 1 Leakage current densities of different insulators on H-diamond

Reference

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