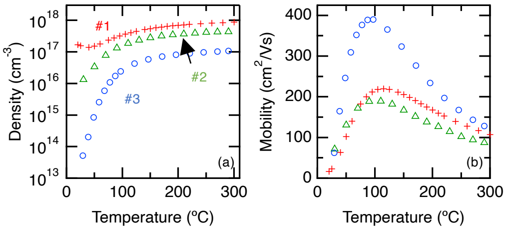

Fig. 1 (a) Shows the temperature dependent Hall effect measurements for 3 β-Ga_2O_3 samples doped with different Si carrier densities. (b) plots the mobilities of the 3 samples as a function of temperature. The RT mobility peak is 129 cm^2/Vs, rising to nearly 400 cm^2/Vs at 98K.

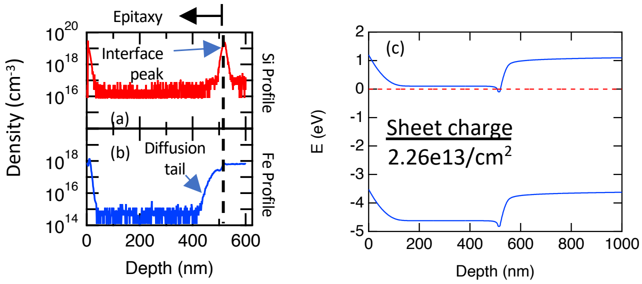

Fig. 2 An unintentionally doped Ga_2O_3 sample was grown by MBE on an Fe-Ga_2O_3 substrate in the (010) orientation. (a) Shows the Si profile obtained by SIMS. At the substrate-epitaxy interface there is a Si peak which which must be compensated in order to obtain non-conducting films. (b) Shows the Fe SIMS profile for the sample. An Fe tail is visible. This arises due to Fe diffusion during the growth of the film from the substrate into the UID layer. (c) Shows the simulated band diagram based on the SIMS data in (a) and (b). From the simulation sheet charge can be calculated. The calculated value of $2.26\times10^{13}/cm^2$ is in good agreement with the experimental Hall effect result of $2.19\times10^{13}/cm^3$.

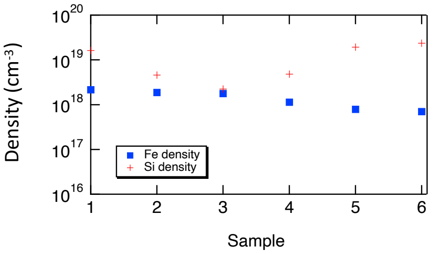

Fig. 3 SIMS was obtained for 6 samples. Plotted are the values obtained for the average Fe value within the substrate, and the Si interface peak value. Depending on the Fe and Si densities the UID films can be insulating or conducting.

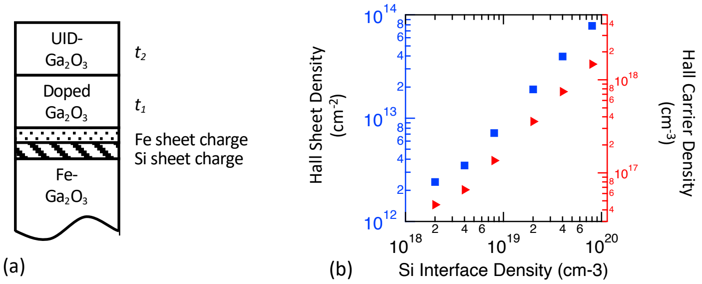

Fig. 4 Simulations were carried out, calculating the impact of different Si interface densities. (a) Shows a cartoon of the sample structure which was used throughout the calculations. The Fe sheet charge and Si sheet charge, correspond to the Fe diffusion tail and Si interface peak values, respectively. The other layers and the substrate are assumed to be uniformly doped with thickness t_1 and t_2. (b) Shows the anticipated sheet charge density, as well as the expected carrier density, for a sample with an average Fe substrate density (based on Fig. 3) and a UID layer of 530 nm (the thickness of the sample shown in Fig. 2). For a sample with an average Fe substrate doping density, it is critical that the Si interface density peak be below 2e18/cm^3. This will result in a net charge which is comparable to what the UID background is for MBE grown films. For thinner samples, however, this interface charge must be lower.

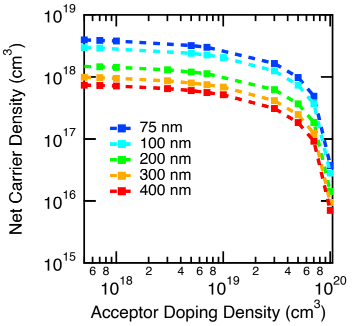

Fig. 5 Since there is variation in the Si and Fe values among substrates, it is prudent to grow a uniformly doped layer on top of the substrate which is doped with compensating acceptors (*e.g.* Mg). The calculations here assume a worst-case scenario. That is, we assume the lowest Fe substrate density (from Fig. 3) and the highest Si interface density (from Fig. 3). The plot shows the anticipated net carrier density which would be measured by Hall effect for a layer which is uniformly doped with a compensating acceptor. The compensating layer thickness and the compensating acceptor density are varied.