Reversible modulation of the UV band in β-Ga_2O_3 (Preliminary Results)

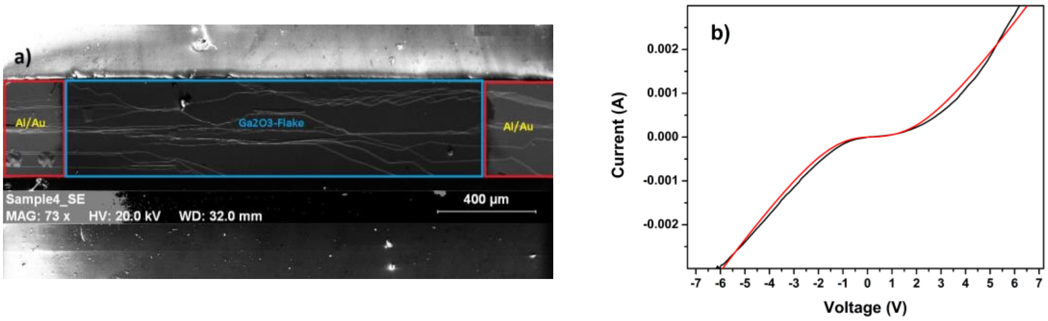

FIG 1 a) SEM image of a metal-Ga_2O_3-metal device b) Typical I-V curve and fit using a back-to-back Schottky diode configuration.

Figure 1 Shows a typical device prepared using a flake of Ga_2O_3 produced by exfoliation. Our preliminary results about the modulation of the UV band attributed to the Self-Trapped Excitons (STE) were obtained in devices similar to this one.

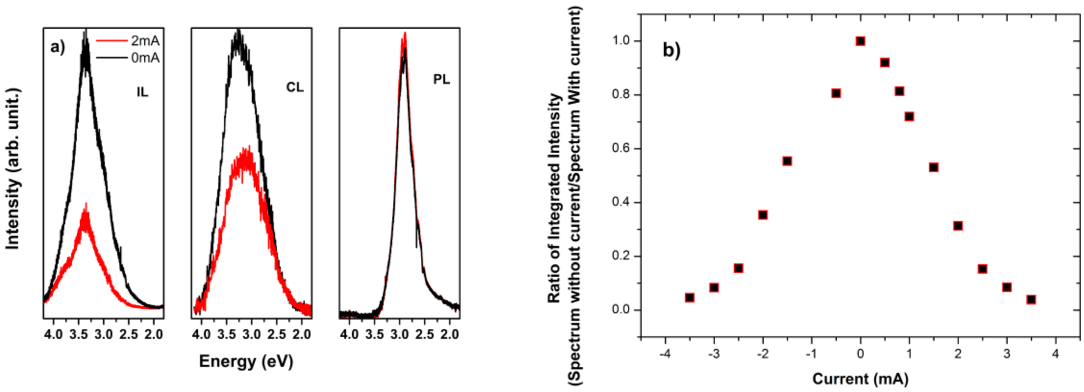

FIG 2 a) Comparison of the luminescence spectra acquired by Ionoluminescence, Cathodoluminescence and Photoluminescence with and without applied curren. b) Integrated intensity without applied current divided by the integrated intensity with current.

Figure 2a) shows the luminescence intensity and shape of the UV band attributed to the STE recombination observed in Ga_2O_3 when excited above the band gap with protons, electrons and photons, by Ionluminecsence (IL), Cathodoluminescence (CL) and Photoluminescence (PL), respectively. This optical characterization was performed without (black line) and with an applied current (red line). The pronounced differences observed in position and shape of the emission bands for the three different techniques are intriguing and will be studied in the present project considering the different depth sensitivities of the three techniques and the role of surface defects on the population and stability of the STE. In the same figure, the red line represents the luminescence when a current of 2 mA is applied. Most interestingly, the luminescence attributed to the STE recombination (observed in IL and CL at 3.38 and 3.26eV) decreases when the sample is excited simultaneously with an applied current while the PL spectrum remains unchanged. This result confirms that the band observed by photoluminescence excited with an energy above band gap (240 nm) does not have the same nature as that observed by IL and CL. Figure 2b) shows the dependence of the integrated IL luminescence intensity (presented as intensity ratio of the intensities with and without applied current) as a function of the applied current. We are now trying to optimize and understand the processes involved in this quenching effect being this one of the objectives of the proposed project.

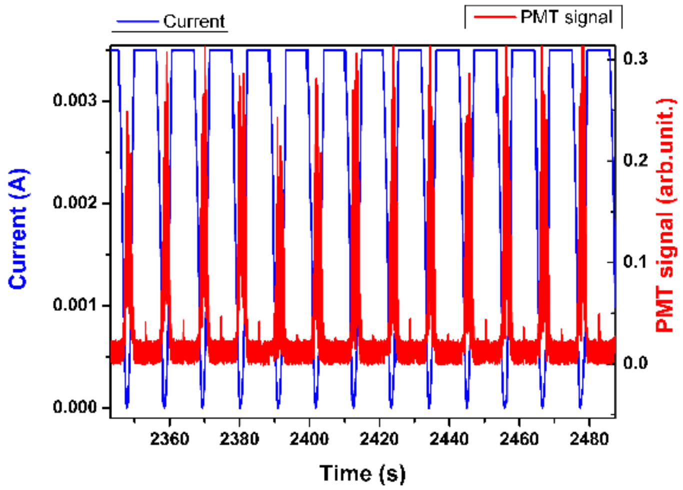

FIG 3 Repeated on/off cycling of the IL intensity as a function of the applied current.

Figure 3) shows a preliminary study on the stability of the luminescence quenching effect as function of a modulated current. As can be observed, the effect is very stable after more than 16000 cycles. This effect was observed for different samples suggesting that it should be due to an intrinsic property of Ga_2O_3 involving the self-trapped-excitons.