Gallium Oxide Thin-Film Field-Effect Transistors for UV Sensing

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Solar blind detectors

The most energetic solar radiation is stopped before reaching the surface.

Solar blind technology (between 200 and 280 nm of wavelength) has the advantage of low background noise and high sensitivity [1]. It can be used for:

- Short distance communications;
- Power grid safety monitoring;
- Medical imaging;
- Environmental and biochemical testing.

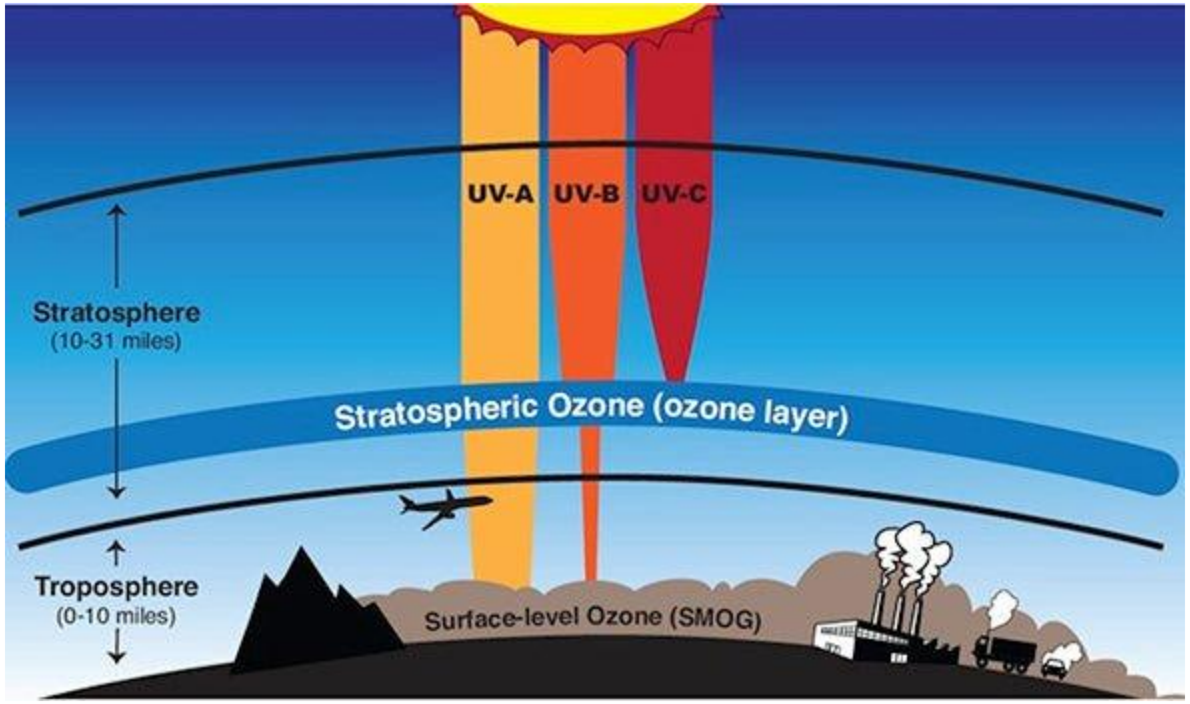

Figure 1:Atmosphere Blocking different bands of UV radiation

Wide Bandgap photodetectors

Dark current: electric current that flows through photosensitive devices (photodiodes, CCDs, PMTs) even when no light is present.

Wide-bandgap photodetectors operate by absorbing photons with energies greater than the semiconductor bandgap, generating electron–hole pairs.

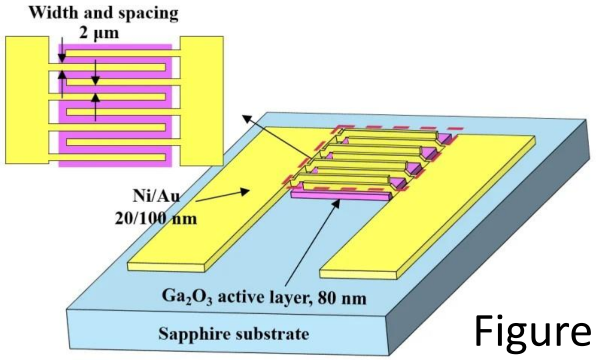

Figure 2: MSM photodetector

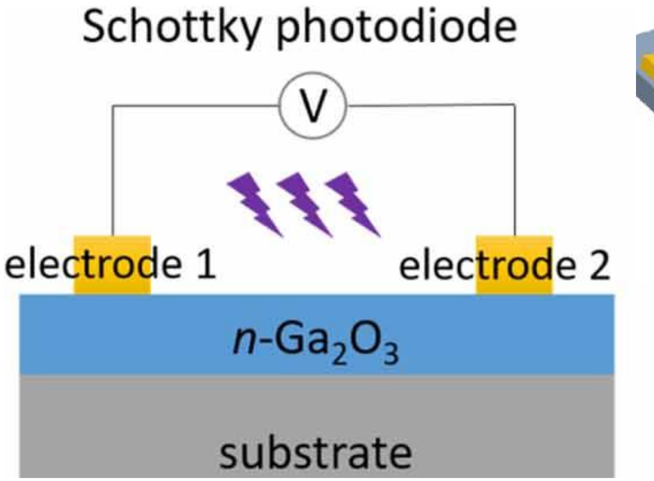

Figure 3: Photodiode photodetector

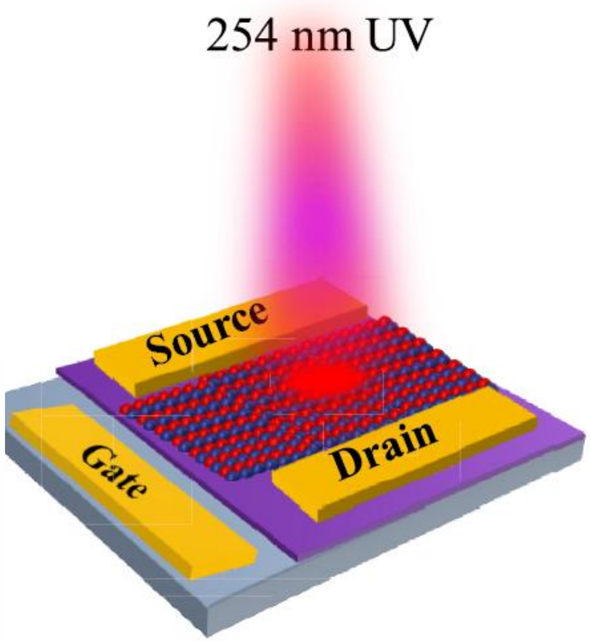

Figure 4: FET photodetector

Intended Field Effect Transistor

- The intended device was designed by Daniela Pereira [3].
- It is a bottom-gate, bottom-contact (BGBC) n-type thin film field effect transistor.
- The metallic gate is a Cr/Au contact buried between the SiO2 and Al2O3 (has a higher dielectric constant than SiO2 and a better adherence to Au) [3].
- The channel will be a Ga2O3 layer deposited last and over the whole structure, maximizing the light exposure.

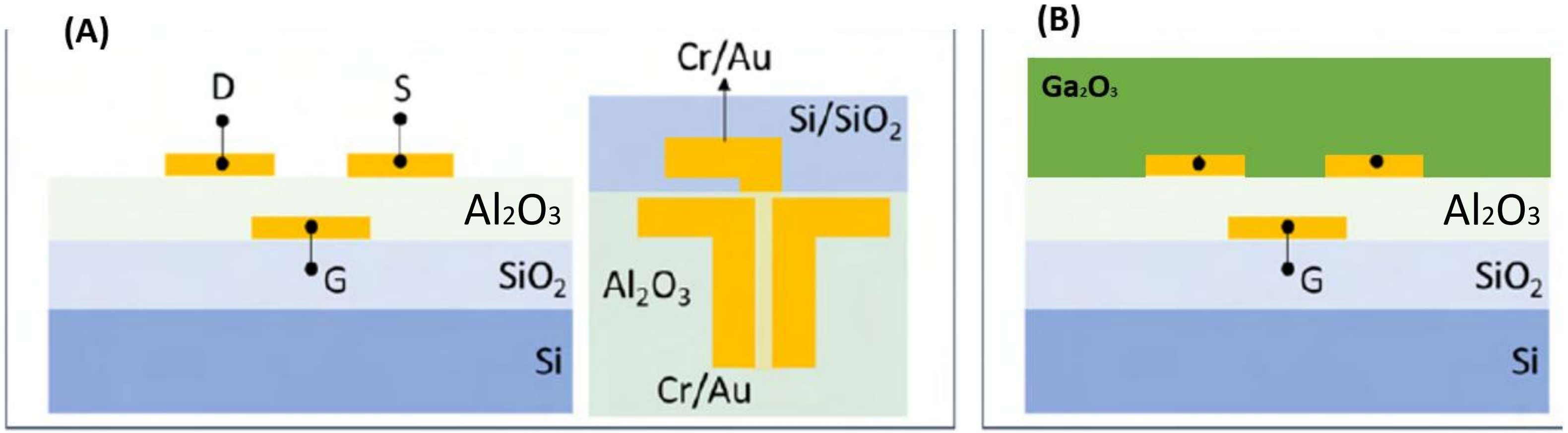

Figure 5: (A): BGBC FET with an Al2O3 insulator layer [3] (B): Intended device

Growth processes:

Depositions performed on substrates:

- Si
- fused silica
- Al_2O_3 over Si
- Al_2O_3 over fused silica (Si_2O_3)

RF Magnetron sputtering

Figure 6:Alcatel SCM 450

Annealing

Figure 7: Tubular oven

Ion implantation

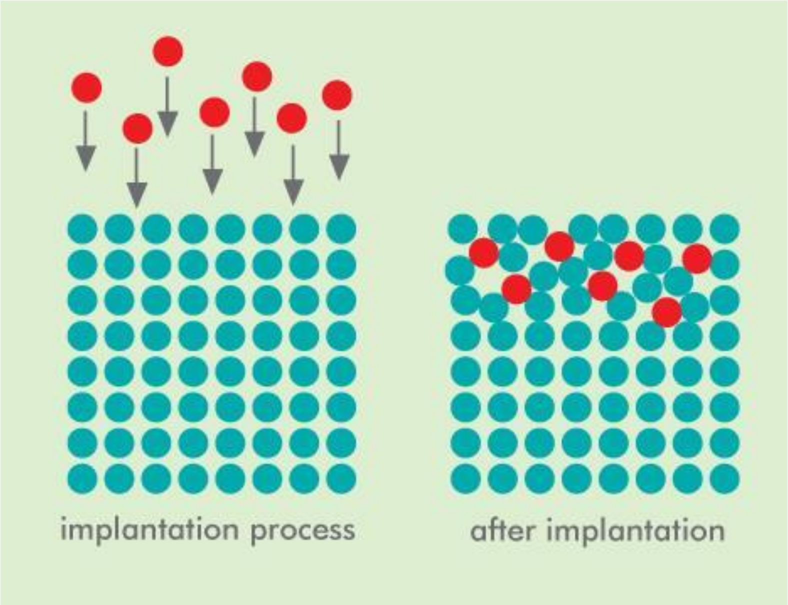

Figure 8: Ion implantation process

Characterization methods:

Evaluation of the grown films:

- Profilometry: to measure the thickness of the film deposited;
- Optical absorbance: to find the Bandgap & defect states;
- Rutherford Backscattering Spectrometry (RBS): to measure the Sn concentration;
- X-Ray Diffraction (XRD): crystallinity & phase;
- Scanning Electron Microscopy (SEM): topography and morphology;
- Electrical measurements (4-point probe and I-V curve): to measure the conductivity

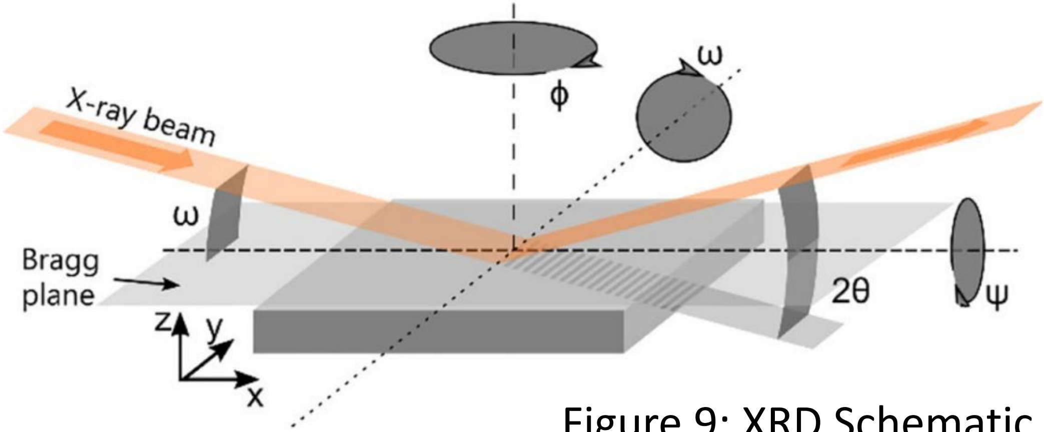

Figure 9: XRD Schematic

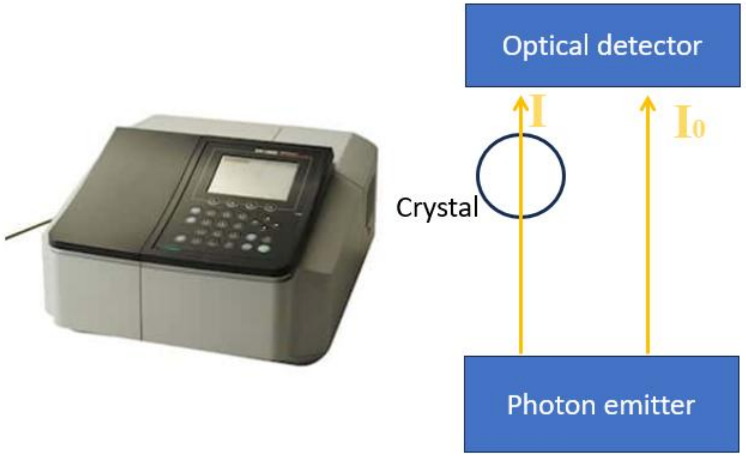

Figure 10: Shimadzu Uv-1800, with a double beam configuration

Bibliography:

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