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Caesium-deposition on GaN as a potential Photocathode

Method

- p-type GaN (magnesium-doped) is used for first experiments
- Wet chemical pre-cleaning is used to remove dust and organic parts from the surface
- The GaN is transferred into UHV chamber via portable suitcase

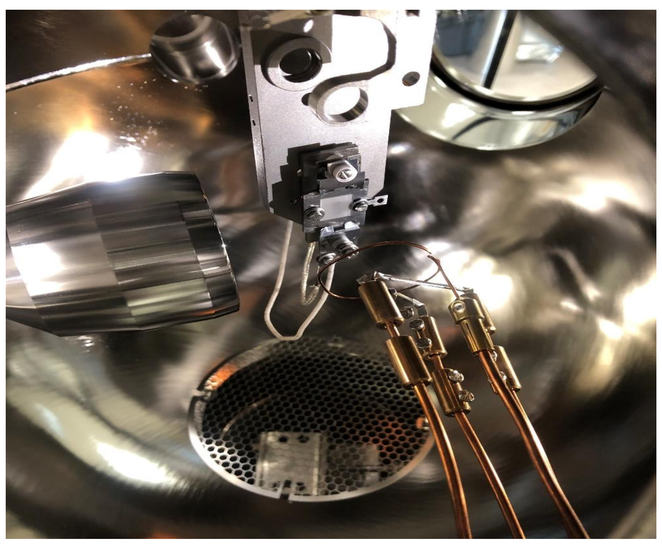


Fig. 1: experimental set-up inside of GaN UHV-chamber

- In UHV the GaN undergoes a cycle process, which consists of the following steps:

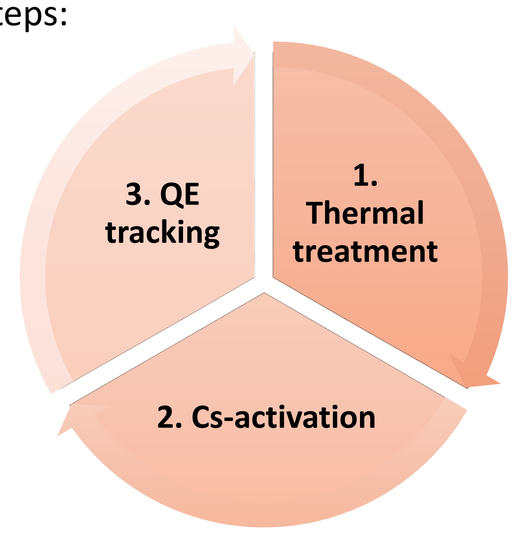


Fig. 2: scheme of cycle process

1) Thermal treatment at certain temperature to desorb residual gases
2) deposition of caesium on clean surface while illuminating with UV-light
3) QE tracking of the prepared GaN:Cs photocathode over time till it drops

→ Starting again with thermal treating and activation process (re-activation)

Quantum efficiency (QE)

- The released photoelectrons enter into the vacuum and are collected by a copper ring anode
- QE is defined as the number of released photoelectrons in ratio of the input photons of UV-light

$$QE = \frac{N_{photoelectrons}}{N_{photons\ of\ UV-light}} \quad (1)$$

$$QE = \frac{h \cdot c}{q_e \cdot \lambda} \cdot \frac{I}{P_{UV-light}} \quad (2)$$

Results

GaN on silicon

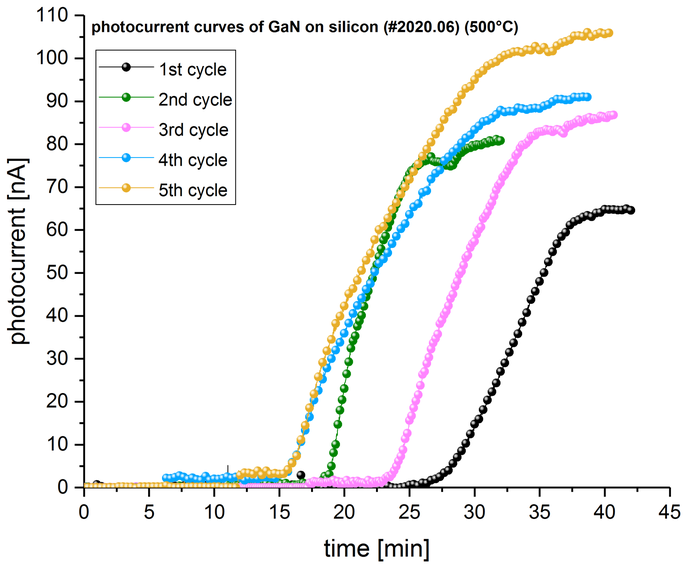


Fig. 3: photocurrent activation curves for GaN on silicon

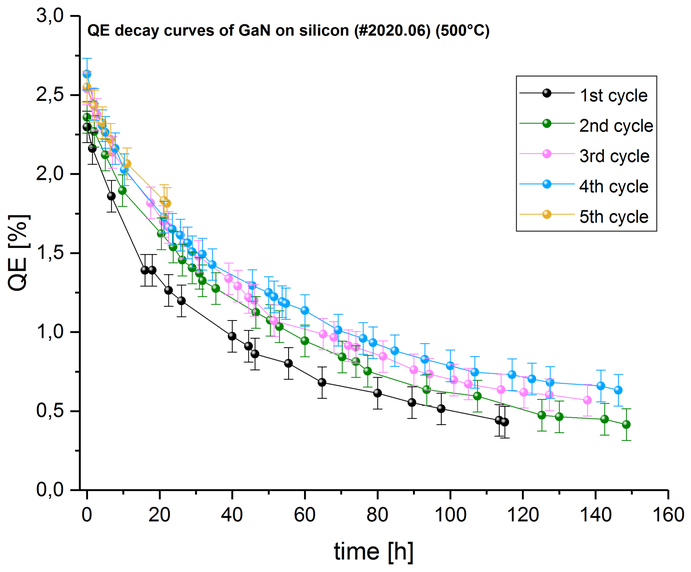


Fig. 4: QE tracking from GaN on silicon

SEM Image

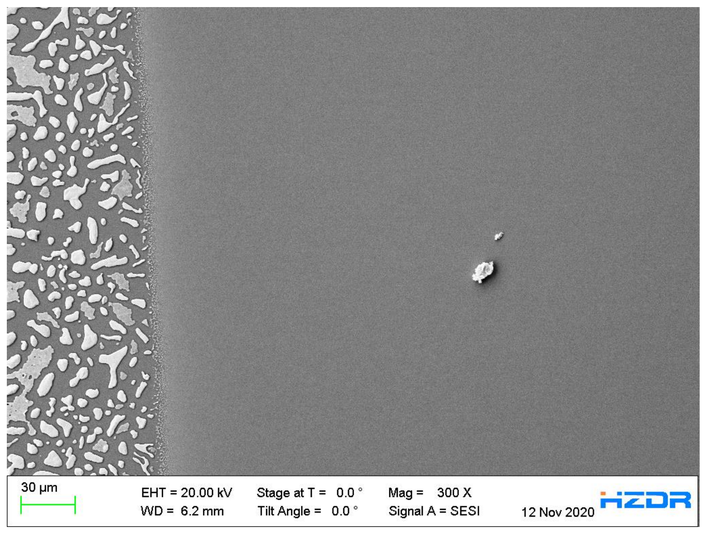


Fig. 5: SEM image of used GaN on silicon

GaN on sapphire

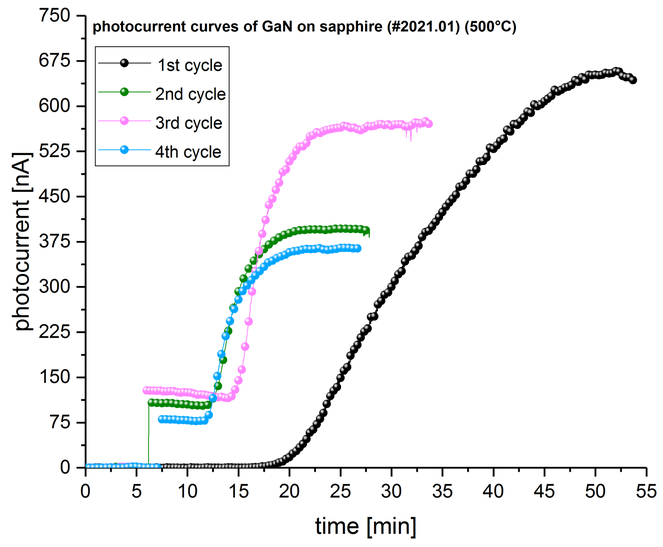


Fig. 6: photocurrent activation curves for GaN on sapphire

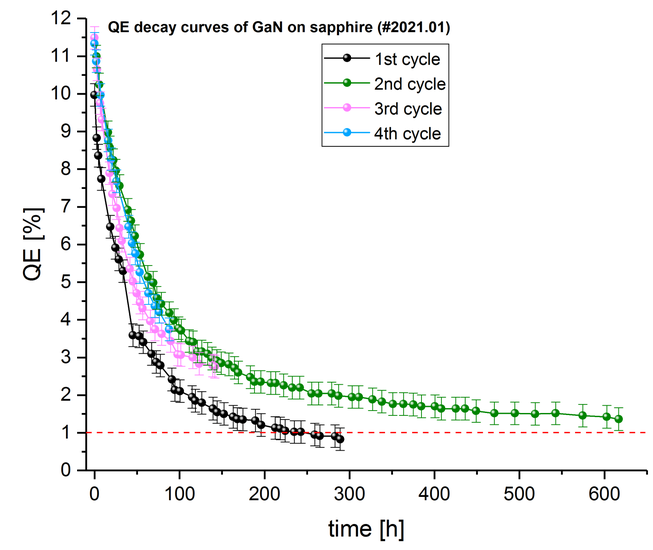


Fig. 7: QE tracking of GaN on sapphire

QE Comparison

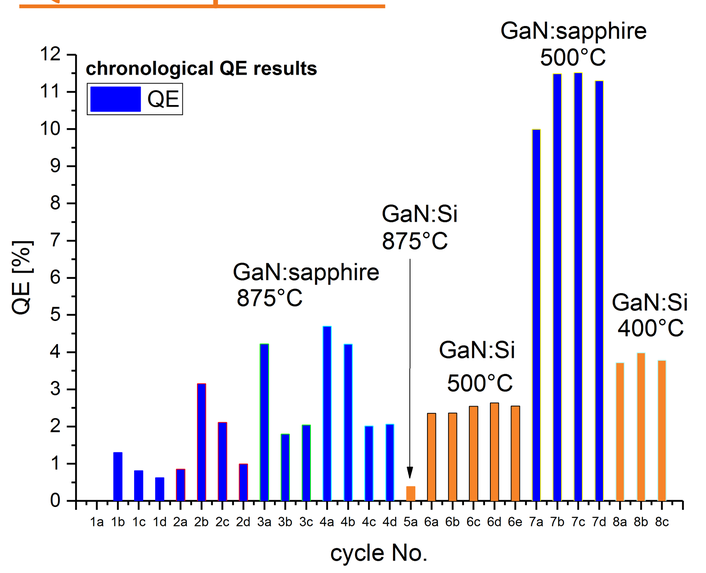
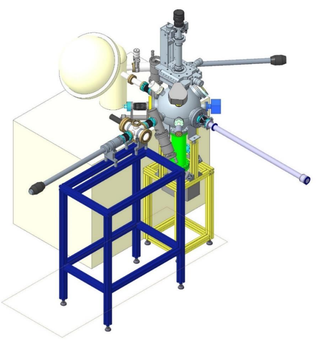


Fig. 8: QE comparison of all activated GaN samples

Outlook

Activation of GaN with caesium and lifetime observation

- on other substrate (SiC)
- use better conductive samples (gold sputtering)
- compare to selfmade GaN (Uni Siegen)



Connection from activation chamber to XPS chamber to do qualitative and quantitative analysis

Fig. 9: combination of GaN chamber and XPS

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