Jana Schaber[1,2], R. Xiang[2], J.Teichert[2], P.Murcek[2], P.Zwartek[2], A.Arnold[2], A.Rhyzov[2], S.Ma[2], N.Gaponik[1]

[1] Helmholtz-Centre Dresden-Rossendorf, Dresden, Germany
[2] Technical University Dresden, Dresden, Germany

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Caesium deposition on GaN to obtain a photocathode

Method

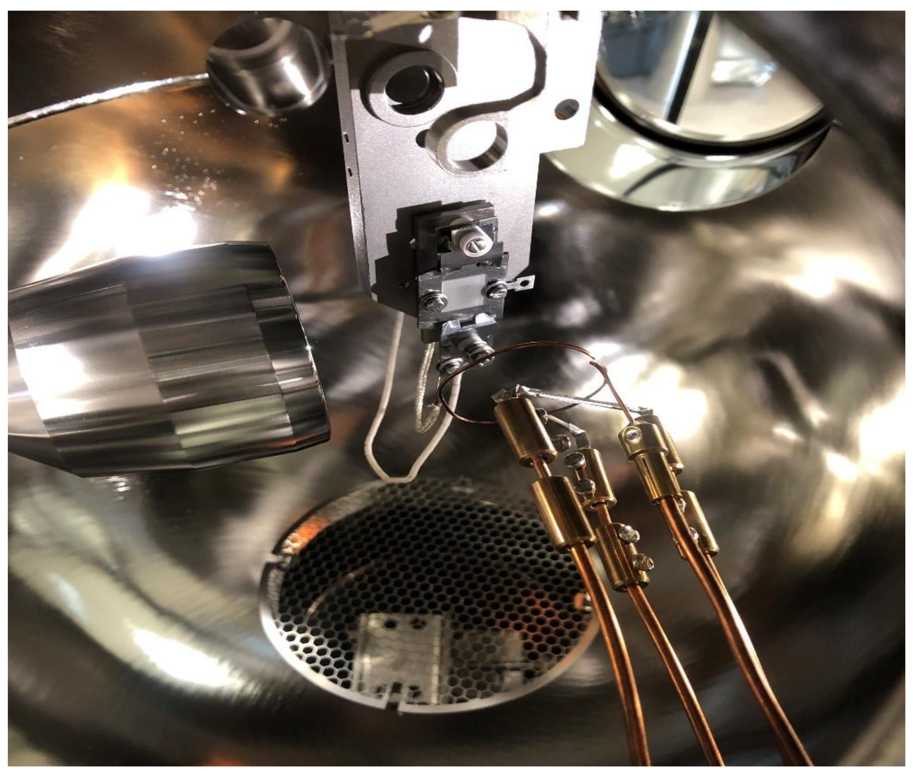


Fig. 1: experimental set-up inside of GaN UHV-chamber

- For first tests p-type GaN (with magnesium doping) on sapphire and later on silicon substrate is studied
- At first the sample is thermal cleaned
- Back at room-temperature the GaN is activated with a thin layer of caesium.
- Using the photoeffect, electrons from the activated GaN material are excited and ejected when illuminating the material with UV-light

- The released photoelectrons enter into the vacuum and are collected by a copper ring anode
- The number of released photoelectrons in ratio of the input photons of UV-light derives in the quantum efficiency (QE)

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

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

Results

1) Thermal treatment at certain temperature to desorb residual gases

2) deposition of caesium on GaN surface by using different caesium fluxes

Simultanously: detection of the photocurrent till saturation is reached

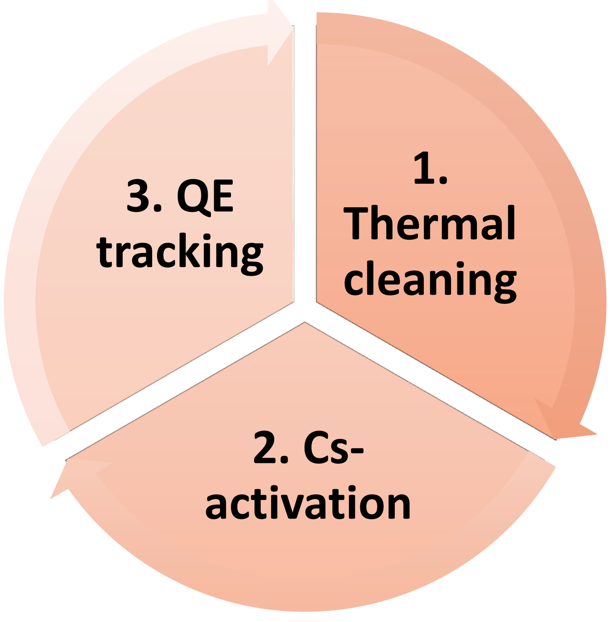


Fig. 2: scheme of cycle process

3) Tracking of the QE of the freshly prepared GaN:Cs photocathode over time till it drops nearly to zero

4) after degradation the material can thermal heated and activated again (re-activation)

GaN on silicon

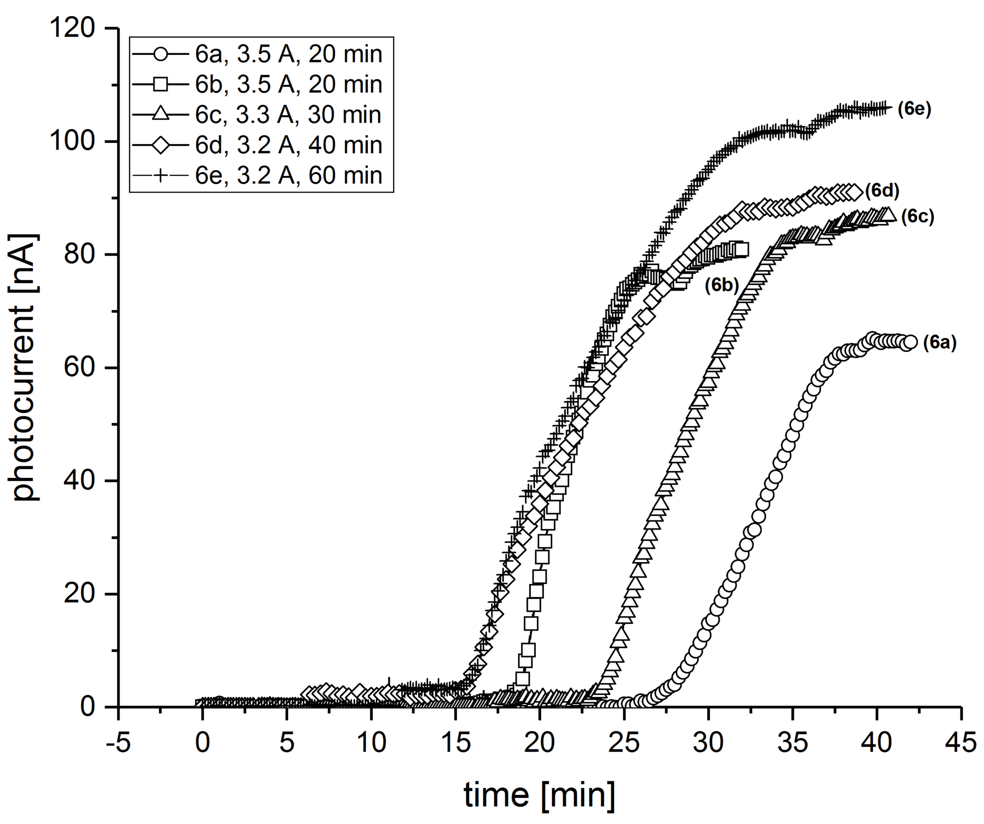


Fig. 3: photocurrent activation curves for GaN on silicon

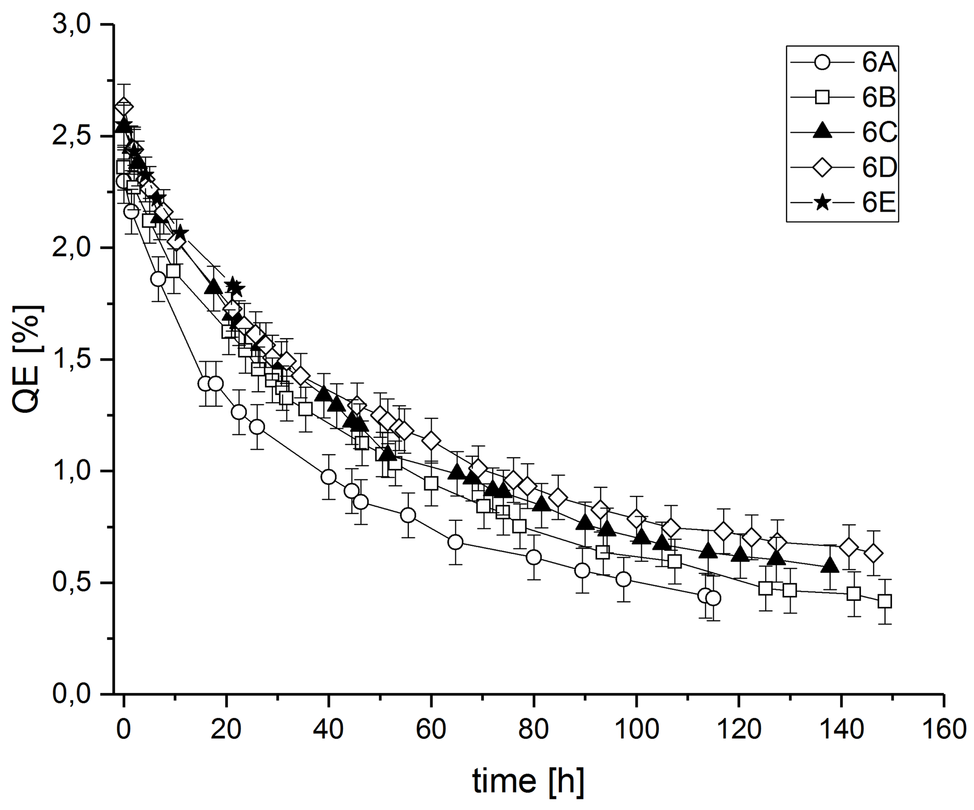


Fig. 4: QE tracking from GaN on silicon

SEM Image

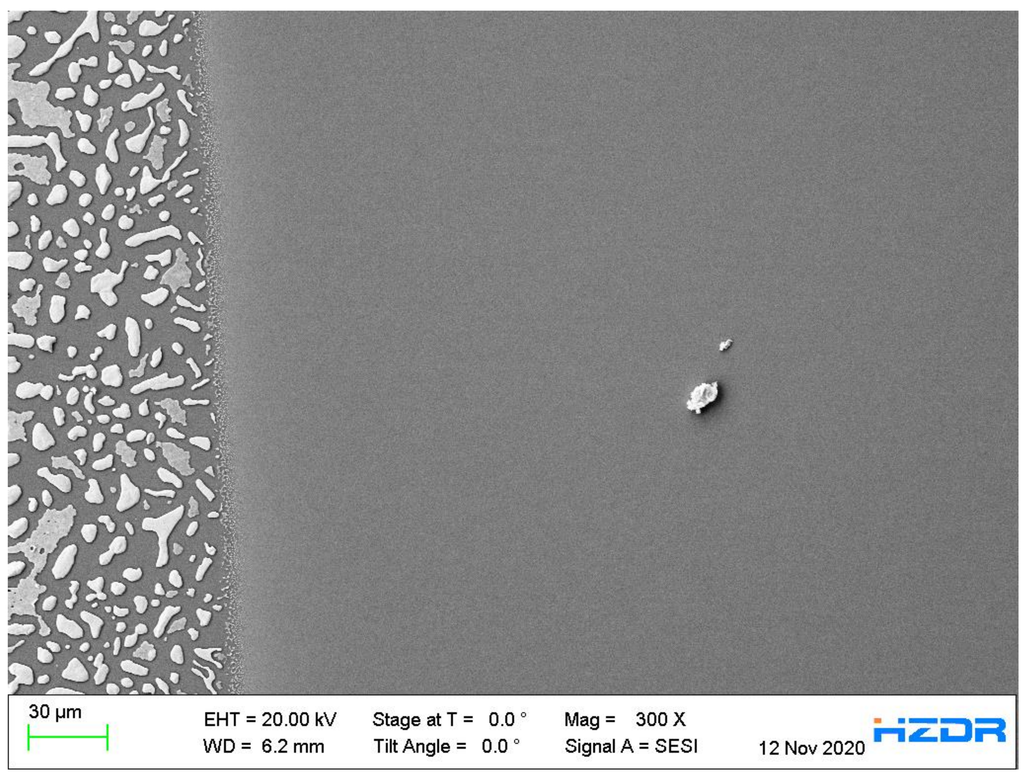


Fig. 5: SEM image of used GaN on silicon

GaN on sapphire

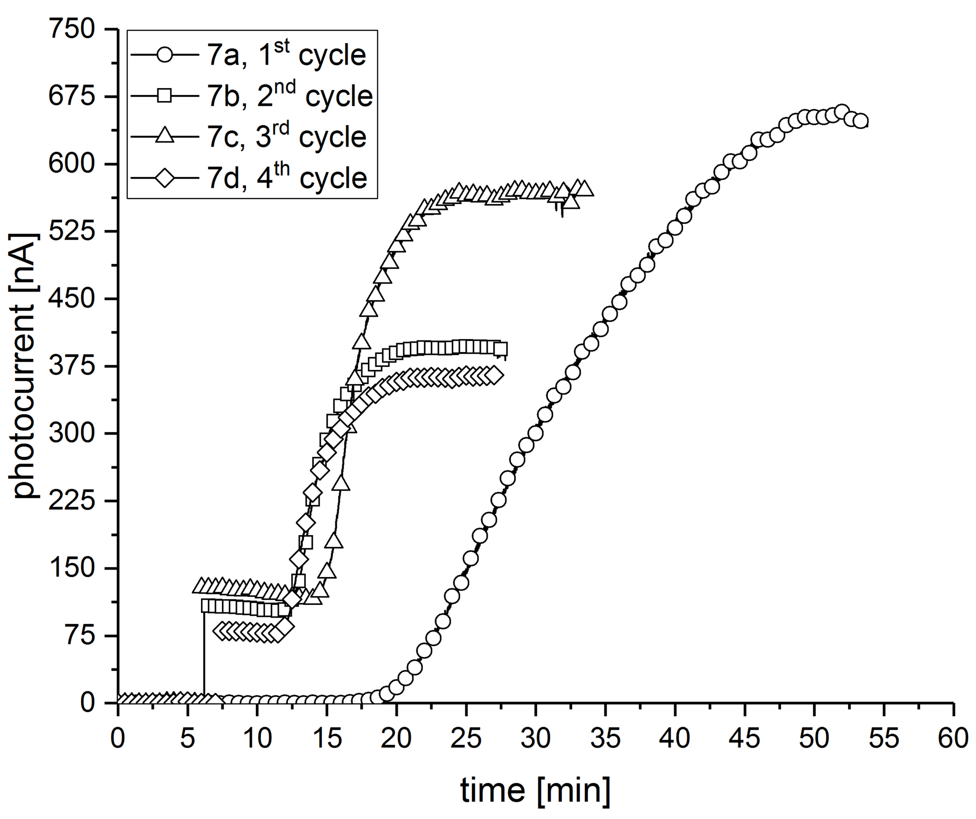


Fig. 6: photocurrent activation curves for GaN on sapphire

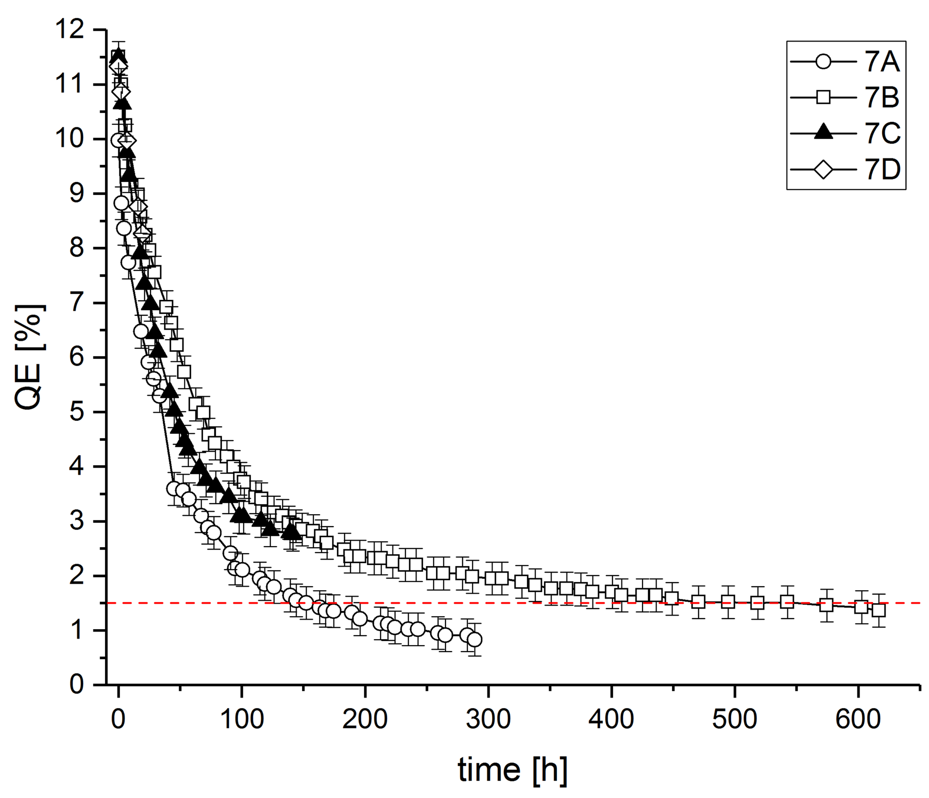


Fig. 7: QE tracking of GaN on sapphire

QE Comparison

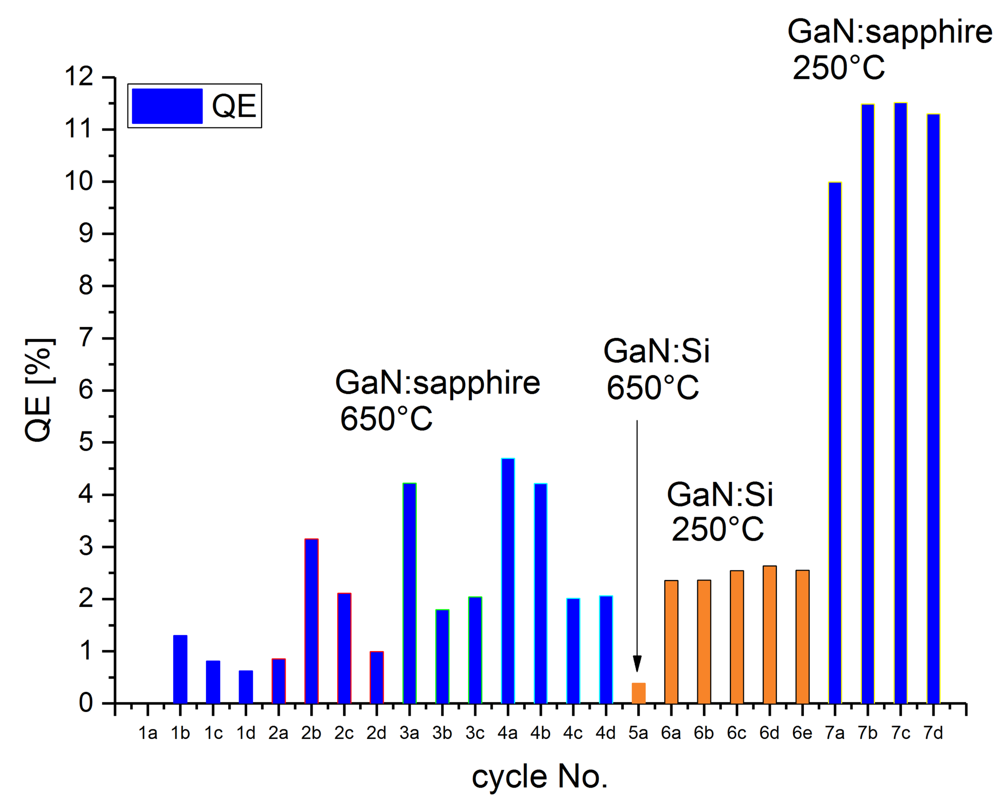
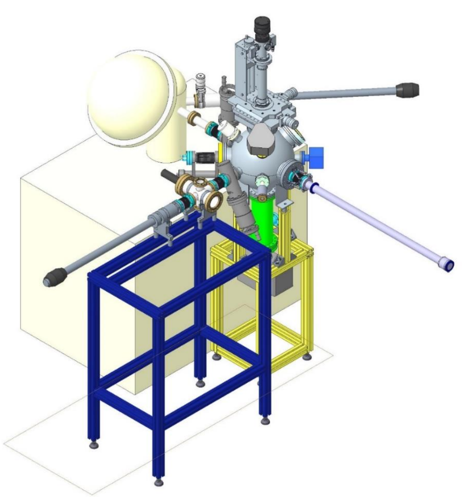


Fig. 8: QE comparison of all activated GaN samples

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

Acknowledgement

We would like to thank all our colleagues at ELBE for their support in this work.
We acknowledge the support of the German Federal Ministry of Education and Research grant 05K12CR1

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