In-situ monitoring of electrochemical etching for thin-film UVB light-emitting diodes

**Background** Light emitters in the ultraviolet (UV) wavelength range have various applications from medical treatments over curing adhesives to water purification. Due to the numerous use cases in daily life, compact and durable light sources are needed. Light emitting diodes (LEDs) provide both a small form factor and stable operation, but so far, the extraction of the photons that are emitted in the active region still limit an efficient operation. Several device designs have been developed to improve the light extraction and reduce reabsorption. The following images show a thin-film flip-chip (TFFC) LED in comparison with a conventional LED design.

![Figure 1: a) Conventional LED design  b) Thin-film flip-chip (TFFC) LED design](image)

**Problem description** The TFFC LED design requires removal of the substrate. This is usually accomplished by lateral wet etching of the semiconductor material (see figure 2). However, UV emitters are based on aluminum gallium nitride (AlGaN) which cannot be etched wet chemically. We have developed an electrochemical process to etch aluminum gallium nitride (AlGaN) layers and to lift-off devices from the substrate. To get a better control over the process, an in-situ monitoring setup has been built, but not tested yet. It will enable to precisely stop the etch process and gain a better understanding of the etch process.

**Thesis scope** Evaluate the in-situ monitored etch process to gain a better understanding and control of the process.

**Methods** Cleanroom fabrication of test structures using lithography, dry etching and metallization. Electrochemical etching of the samples to explore the process. Analyze samples with scanning electron microscopy.

**Contact at the Photonics laboratory, Department of Microtechnology and Nanoscience**
Supervisor: Michael Bergmann (michael.bergmann@chalmers.se), Room: B414
Examiner: Åsa Haglund (asa.haglund@chalmers.se), Room: B417