

# Thermal and optical simulations of blue- and UV-emitting VCSELs

## Background

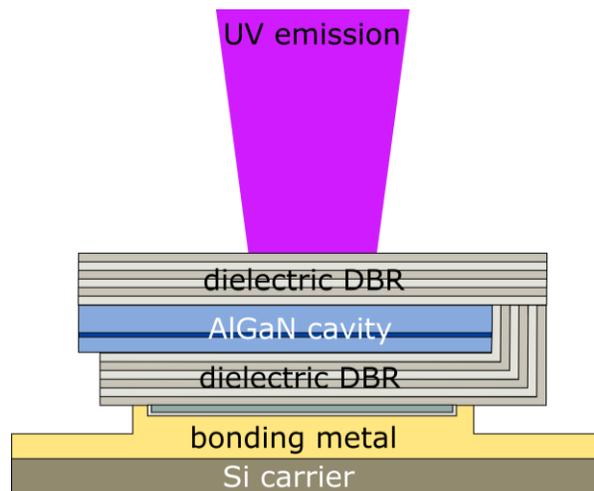
Several research groups have reported electrically injected GaN-based vertical-cavity surface-emitting lasers (VCSELs) emitting in blue spectral range. However, their performance still needs improvement to reach commercialization. Furthermore, up until recently there were no demonstrations of UVB- or UVC-emitting VCSELs, even under optical pumping. At the Photonics Laboratory at MC2, we have developed a successful method to underetch and remove III-nitride films with precisely controlled thicknesses from their native substrate. Using this method, we have demonstrated the world's first UVB-emitting VCSEL and are developing electrical injected (Al)GaN-based VCSEL, both for the blue and UV spectral range. To improve these devices further, simulations are needed. The simulations will contribute to a better understanding of the thermal and optical properties of our devices and provide valuable input for future device designs.

## Thesis scope

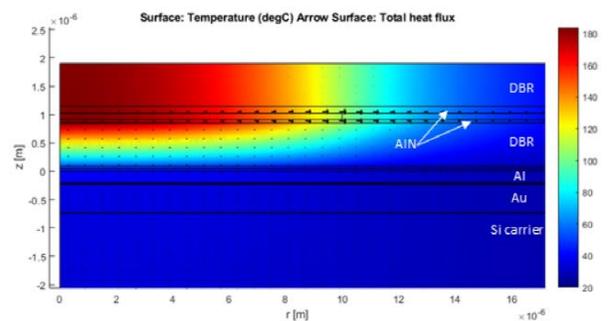
The goal of this thesis is to simulate the thermal and optical properties of different VCSEL structures. Specifically, you will connect how the thermal heat generated during operation will affect the optical properties, such as resonance wavelength and threshold gain and, in turn, how this affects the electrical or optical pumping needed to reach lasing. Possibly, simulations of the current flow to get a more realistic heat source distribution can be performed. If time permits, you may also have the opportunity to verify your results experimentally.

## Methods

During the project you will build on thermal and optical simulation software previously developed by our group (Matlab and COMSOL). The main part of your simulations will be performed using Matlab and you will also need to make a literature survey to find realistic material parameters for the simulations.



An optically pumped UVB-emitting VCSEL



Simulated thermal profile of an UV-emitting VCSEL

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