MONASH
ENGINEERING

MONASH University

Faculty of Engineering
Summer Research Program 2022-2023

Project Title: Nanolasers

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Objective
The students will design sub-wavelength scale plasmonic cavities to couple with monolayered semiconductors to achieve nano-lasers. You will start with modelling a few cavity designs to investigate the optical losses in each design. You will look at material gain models, and identify the most promising combination of cavity and gain material to achieve nano-lasers.

Project Details
Monolayers of transition metal dichalcogenides (TMDs) are direct bandgap semiconductors with material gain comparable to III-V semiconductors, traditionally used in lasers. The monolayer configuration makes it relatively easy to couple TMDs to micro/nano-cavities for achieving lasers with small footprint. The monolayer configuration is also promising for demonstration of flexible devices.

There are a few reports in the literature on design of photonic cavities for demonstration of TMD lasers. Photonic cavities have physical dimensions larger than the wavelength of interest. We aim to design sub-wavelength scale plasmonic cavities to couple with TMDs to achieve nano-lasers.

This will be a computational project to start with. A good understanding of Maxwells' electromagnetic theory, solid state physics and coding skills in Matlab are essential. Following the design of lasers, we may float an experimental project on laser demonstration for next semester.

Prerequisites
This will be a computational project to start with. A good understanding of Maxwells' electromagnetic theory, solid state physics and coding skills in Matlab are essential.

Additional Information
https://www.nature.com/articles/nphoton.2015.197

https://www.nature.com/articles/nature14290