Bridging the Green Gap: Developing High-Power Green Lasers with excellent beam qualities

Imagine the vibrant green of a laser module but with the power to revolutionize industries, from medical imaging to communications. This is the ambitious goal of our project: to develop high-beam-quality, high-power green light-emitting lasers known as Vertical Extended Cavity Surface Emitting Lasers (VECSELs).

The Challenge: The "Green Gap"

Creating efficient green light emitters has been a long-standing challenge in semiconductor technology. Known as the "green gap," this problem arises due to difficulties in producing green light using traditional semiconductor materials. In Phosphide/Arsenide compounds, direct-to-indirect bandgap transitions impede green light emission. For nitride semiconductors like InGaN, increasing strain in quantum wells as emission wavelengths shift towards green results in reduced efficiency and quality.

Our Solution: VECSELs with Blue Laser Diode Pumping

To overcome these hurdles, we propose using blue laser diodes, which are highly efficient, as primary light sources in an optical pumping scheme for VECSELs. By using optical pumping, we avoid the detrimental effects of high-temperature overgrowth of p-type layers, thereby preserving the quality of quantum wells.

VECSELs offer several advantages over traditional VCSELs (Vertical Cavity Surface Emitting Lasers):
1. **High Beam Quality**: Producing high-quality circular beams suitable for various applications.
2. **Scalability**: Power can be increased by scaling pumping power and surface of the device.
3. **Nonlinear Integration**: Potential to incorporate nonlinear crystals for second harmonic generation, or saturable absorbers for enhancing versatility of use..