


# Wavelength Control of VCSELs using High-Contrast Gratings

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The vertical-cavity surface-emitting laser (VCSEL) is a well-established light source for sensing and short-reach optical links. The surface emission allows wafer-scale testing enabling low-cost manufacturing, while the VCSELs' small modal volume leads to low power consumption, high-speed modulation at low currents, and small footprint [1]. Conventional VCSELs consist of an active region sandwiched between two distributed Bragg reflectors (DBRs). Replacing the top DBR with a high-contrast grating reflector offers unique possibilities to engineer and control VCSEL emission wavelength and modal properties [2,3].

A high-contrast grating (HCG) is typically formed by bars of high refractive index material suspended in air. For certain grating parameters (duty cycle, period, and thickness), HCGs can function as ultra-thin reflectors with close to 100% reflectivity [4]. Besides reflectivity, the grating parameters also influence the reflection phase. This enables fabrication of multi-wavelength VCSEL arrays by fabricating HCG-VCSELs with different grating parameters [2]. However, in order to utilize the extraordinary properties of the HCG, the VCSEL mode must be sensitive to the HCG, which leads to complicated cavity configurations with coupled cavity effects and low optical confinement.

This talk will summarize work performed at Chalmers University of Technology in collaboration with Hewlett Packard Enterprise. The design of HCGs and HCG-VCSELs will be presented as well as fabrication and experimental results from 980 nm HCG-VCSELs. Finally, multi-wavelength HCG-VCSEL arrays will be presented [5].

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