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Reliability and spectral stability of 2.65 µm semiconductor laser diodes

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Abstract

With the development of high-performance mid-infrared semiconductor laser diodes for gas detection instruments, it is important to ensure that the diode performance is reliable over prolonged periods of operation and in harsh operating conditions. Even so, the published literature lacks comprehensive reliability studies of laser diodes emitting in the 2 to 4 µm wavelength regime. This talk discusses results from a reliability and life-test study performed on laser diodes exposed to accelerated aging in the form of high drive currents at elevated temperatures. The recently developed GaSb-based distributed-feedback diodes use laterally-coupled gratings to impose an emission wavelength of 2.65 µm. The diodes were biased at a constant current of 0.5 A and mounted on a copper plate kept at 40°C. At this combination of drive current and temperature, the devices had not yet reached thermal rollover and emitted almost 10 mW of optical power from a single, antireflection-coated facet. We have submitted several devices to more than 3,000 hours of accumulated accelerated aging and have not seen a single failure. In fact, the output power has remained stable within the measurement precision throughout the reliability test period for all devices. During an initial burn-in period of approximately 100 hours the emission wavelength of the laser devices blue shifts up to 2 nm, owing to annealing processes that affect the electro-optical properties. After this burn-in period, the spectra stabilize and show no further significant changes. These measurements offer evidence to the robustness of our devices and the reliability of our fabrication process.

Biography

Carl Borgentun is currently pursuing postdoctoral studies in the Microdevices Laboratory at the Jet Propulsion Laboratory, California Institute of Technology, in Pasadena, USA. He received his M. Sc and Ph. D from Chalmers University of Technology in Gothenburg, Sweden in 2012. Borgentun is the author of several scientific papers published in distinguished journals regarding the design, fabrication, and characterization of semiconductor lasers.