Magnetic Field Alteration of Semiconductor Laser Diode Emission Geometry

Ernest M. Kim, University of San Diego

The effect of static magnetic fields was conducted on commercially available 780nm and 650 nm semiconductor laser diodes commonly used in compact disk (CD), Digital Video Disk recorder/players, and laser pointers. The laser diodes used in these commercial applications have shifted from exclusively multimode Fabry-Perot laser to either multi- and single-mode emission spectra and can achieve high optical output powers of 40 mW and greater.

Studies of the effect of static magnetic fields on laser diodes emission geometry were conducted below and above threshold current. Results indicate that the emission geometry (near-field pattern) is altered and is dependent on the direction of the magnetic field to the major and minor axis of the emission. The emission geometry is altered with when applying higher magnetic fields to the device under test. The magnetic fields were applied so that the field lines were perpendicular to the direction of optical emission and either perpendicular to the major axis or the minor axis of the emission geometry.

The laser diodes were excited with currents ranging from 4 mA (significantly below threshold) to above threshold at laser recommended operating currents. The recommended operating currents varied from 50 mA to approximately 70 mA. The operating temperature was held to within 2 degrees of ambient.

Measurements made on the prototypical elliptical emission geometry of the laser diodes included the x and y axis center of the emission region, 4 x sigma major-axis, 4 x sigma minor-axis, azimuthal angle between the principal axis and the x-axis, and ellipticity (minor/major diameter). The magnetic field was generated by stationary static magnets (e.g., Neodynium Grade 42 magnet with residual flux density better than 13.4KGs).

Below threshold measurements yielded significant changes in the ellipticity of the emission geometry. At very low applied currents that were significantly below threshold, the change in ellipticity approached 20%.