Simulation of High-Power Semiconductor Lasers with WIAS-TeSCA

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High-power semiconductor lasers are needed for a number of applications, such as for pumping of solid-state lasers and optical fiber amplifiers, nonlinear optical frequency conversion, medical treatments and material processing. The different requirements concerning the emission wavelength, optical power, beam quality and spectral purity necessitates the development of a large variety of lasers tailored to the corresponding application. Because state-of-the-art lasers operate at the frontiers which is physical and technological feasible, simulation is a must in order to reach the required electro-optical parameters and to reduce technological cycles.

The two-dimensional simulator `WIAS-TeSCA` has two capabilities built-in to simulate lasers. The first one varies the optical power as an additional parameter in the drift-diffusion equations for the transverse plane and calculates a look-up table to be stored in a file, which is subsequently used by another program (written at HU Berlin and FBH) to calculate the power-current and other characteristics. The second capability is based on the solution of an additional balance equation for a longitudinal-averaged optical power and yields directly the power-current characteristics.

In my talk, I will address the pros and cons of both methods presenting results on the mode competition in ridge-waveguide lasers as well as the power-current characteristics of broad-area lasers. Comparisons with experimental results will be also given.