Microcavity Laser Diode Model

-Application to surface relief VCSEL

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20 years
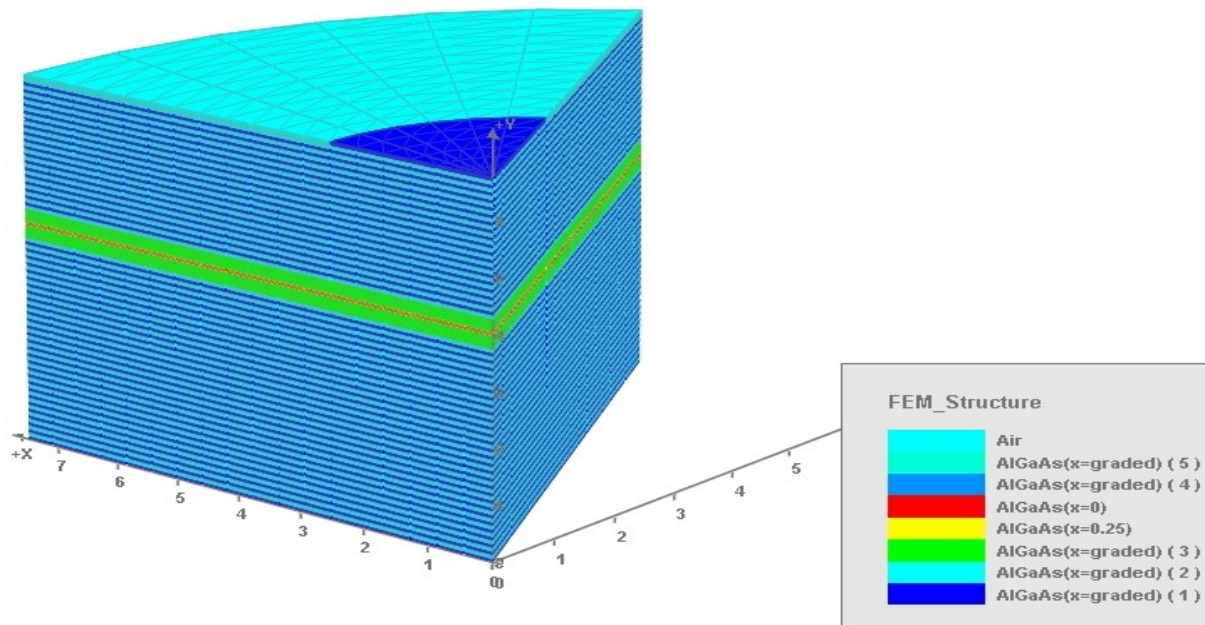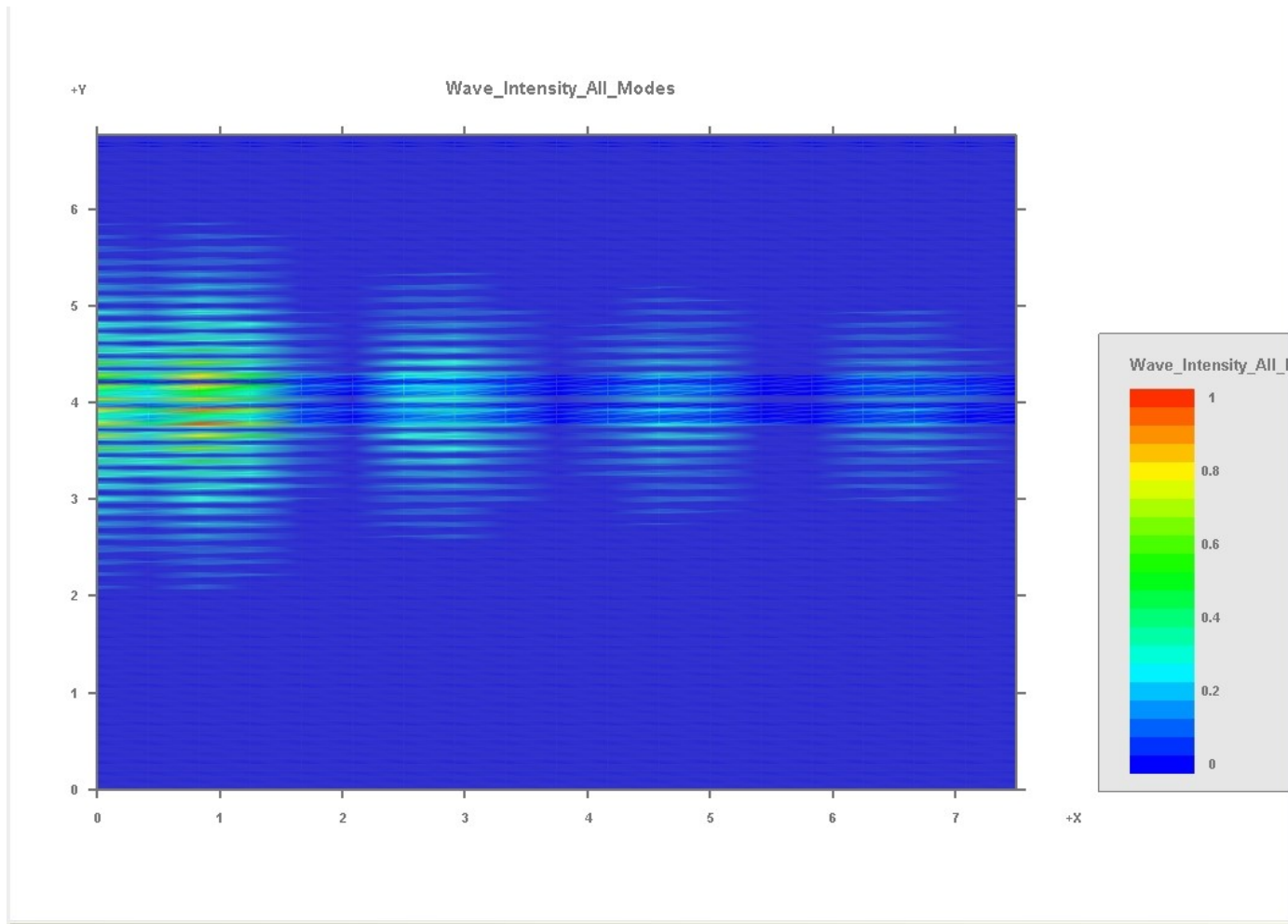
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Microcavity model

➤ Rigorous solution of Maxwell wave equation with no need to separate lateral and longitudinal modes.

➤ Arbitrary FEM mesh structure.

➤ PML boundary to define power exit.

➤ Coupling to optical gain and drift-diffusion models to achieve full self-consistency.

➤ Multicavity eigen mode solution with multiple wavelength operation.

➤ Perfect tools for surface relief VCSEL simulation where longitudinal/lateral mode coupling determines modal behavior.
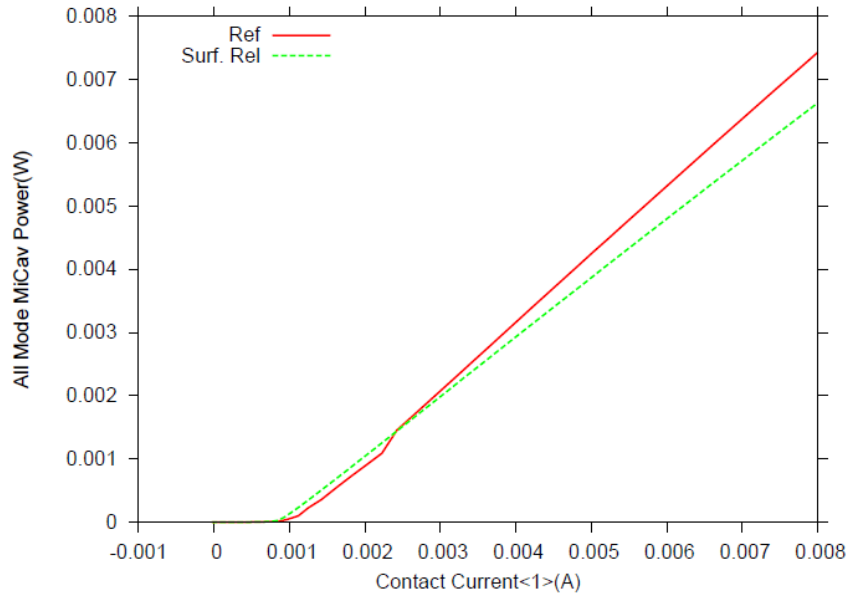
FEM Structure

Surface relief (SR) VCSEL

FEM_Structure

- Air
- AlGaAs(x=graded) (5)
- AlGaAs(x=graded) (4)
- AlGaAs(x=0)
- AlGaAs(x=0.25)
- AlGaAs(x=graded) (3)
- AlGaAs(x=graded) (2)
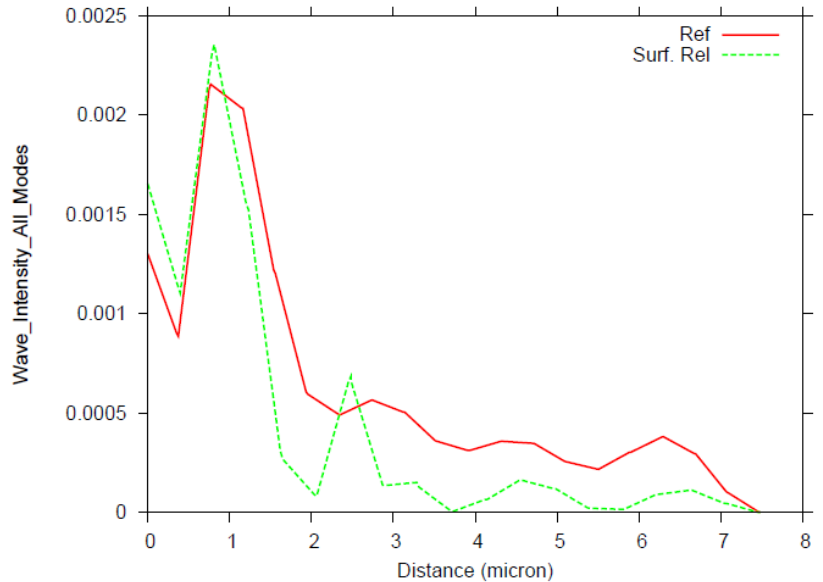- AlGaAs(x=graded) (1)

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All-mode wave intensity

Comparison with ref. wo SR

All-mode emission power vs. current.

Top surface near field pattern from all-mode power intensities.

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Summary

➢ A technical breakthrough for microcavity laser diode simulation.

➢ Accurate prediction for wavelength, near-field pattern, far-field pattern as well as thermal-electrical behavior.

➢ Highly efficient computation with use of high performance GPU acceleration.

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