PROCEEDINGS PAPER

Comparison between Adachi and Lorentzian models of semiconductor materials for FDTD implementation of femtosecond pulse propagation

Author(s): **Steven A. Matsumoto; Richard I. Joseph; Raymond M. Sova; Michael E. Thomas**

Published: **23 December 2004**; 11 pages; 35 papers;
DOI: **10.1117/12.578282**

Paper Abstract

The development of high-speed integrated photonic devices requires accurate modeling tools, especially for high-bandwidth devices and devices operating near the bandgap. Models of femtosecond pulse propagation in a semiconductor are typically developed in the time domain and must include dispersion and loss effects because of the extensive bandwidth. In the past, approximate “classical” models such as the Lorentzian model of the optical properties have been used to study pulse propagation of femtosecond pulses in semiconductors. Quantum-mechanical models such as that developed by Adachi provide accurate spectral characteristics of dispersion and loss as a function of temperature. The present work describes a detailed comparison between the two approaches. In solving realistic problems, numerical methods such as FDTD must be employed. This requires a time domain representation of the susceptibility. For the case of a simple resonator structure, an exact analytic time domain solution was previously obtained using the classical model. This can be used to verify the appropriateness of our numerical solutions when applied to the more complicated Adachi model. The Adachi model more accurately takes into account the absorption features near the band edge, which can profoundly affect the pulse shape in the femtosecond regime. In this comparative study, these effects are examined for simple resonator structures which contain GaAs.

This paper was published in SPIE Proceedings Vol. 5620
Solid State Laser Technologies and Femtosecond Phenomena, Jonathan A. C. Terry; W. Andrew Clarkson, Editors, pp.228-238