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Abstracts of Papers to Appear

An Efficient Method for Band Structure Calculations in 3D Photonic Crystals. David C. Dobson, Jayadeep Gopalakrishnan, and Joseph E. Pasciak. *Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368.*

A method for computing band structures for three-dimensional photonic crystals is described. The method combines a mixed finite element discretization on a uniform grid with a fast Fourier transform preconditioner and a preconditioned subspace iteration algorithm. Numerical examples illustrating the behavior of the method are presented.

Low Frequency Finite Difference Time Domain (FDTD) for Modeling of Induced Fields in Humans Close to Line-Sources. Michael E. Potter,* Michal Okoniewski,† and Maria A. Stuchly.* **Department of Electrical and Computer Engineering, University of Victoria, P.O. Box 3055, Victoria, British Columbia, Canada, V8W 3P6; and †Department of Electrical and Computer Engineering, University of Calgary, 2500 University Drive, Calgary N.W., Alberta, Canada, T2N 1N4.*

The implementation of a low frequency line-source as a source function in the finite difference time domain (FDTD) method is presented. The total/scattered field formulation is employed, along with a recently developed quasi-static formulation of the FDTD. Line-source modeling is important in the utility industry, where a more accurate prediction of the fields induced in workers in close proximity to power lines is required. The line-source representation is verified, and excellent agreement with analytic solutions is found for two object problems. A practical example of the electric fields and current densities induced in a human body in close proximity to a 60 Hz transmission line is evaluated. The results for predicted organ dosimetry for such a configuration are compared with predictions for the uniform electric field, and demonstrate the induced fields and current densities can be significantly higher than originally predicted for uniform electric field exposure on a ground plane.

A Level-Set Method for Simulating Island Coarsening. D. L. Chopp. *Engineering Sciences and Applied Mathematics Department, Northwestern University, Evanston, Illinois 60208.*

Modeling of microstructural evolution during thin-film deposition requires a knowledge of several key activation energies (surface diffusion, island edge atom diffusion, adatom migration over descending step edges, etc.). These and other parameters must be known as a function of crystal orientation. In order to generate values for these parameters, we have developed a numerical simulation in tandem with physical experiments. By tuning the simulation to the results from experiments we can extract and verify approximate values for these parameters. The numerical method we use is based upon the level set method. Our model is a continuum model in directions parallel to the crystal facet and resolves each discrete atomic layer in the normal direction. The model includes surface diffusion, step edge dynamics, and attachment/detachment rates, all of which may depend upon the local geometry of the step edge. The velocity field for advancing the island edges in the level set framework is generated by computing the equilibrium adatom density on the flat terraces resulting in Laplace's equation with mixed boundary conditions at the step edges. We have turned to the finite element method for solving this equation, which results in very good agreement with analytically known solutions and with experiment.

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MODELING OF EVANESCENT ENERGY IN OPTICAL FIBERS.

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Optical fibers have found important applications in chemical imaging and single particle detection. The applications make use of the propagating evanescent energy existing outside the core of a fiber. In this paper, a variational method for solving two-dimensional Helmholtz eigenvalue problems for a core of arbitrary shape is described. The method reduces the problem in the infinite domain to a bounded one by using a transparent boundary condition. It is shown that the variational formulation does not produce spurious solutions. An optimal error estimate is obtained for the associated finite element method. Finally, numerical experiments indicate that square fibers yield sufficient evanescent energy for imaging application.

A LANCZOS APPROACH TO THE INVERSE SQUARE ROOT OF A LARGE AND SPARSE MATRIX.

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I construct a Lanczos process on a large and sparse matrix and use the results of this iteration to compute the inverse square root of the same matrix. The algorithm is a stable version of an earlier proposal by the author. It can be used for problems related to the matrix sign and polar decomposition. The application here comes from the theory of chiral fermions on the lattice.