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Surface plasmon polaritons in metal strip waveguides with anisotropic substrate materials

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Abstract

The fundamental challenge in the design of plasmonic waveguides is the management of the trade-off between mode confinement and the propagation range. The propagation range in plasmonic waveguide structures is limited by Joule losses, associated with the metallic region of the structure. One method of dealing with this problem is the application of anisotropic dielectric materials. Presently, with the availability of engineered photonic materials with strong anisotropy, the design of plasmonic components with anisotropic substrates has become an important area of research. Further, anisotropy gives additional method of controlling propagation in a waveguide.

Analysis of surface plasmon propagation in nano-metal strip waveguides using materials with various types of anisotropy has been carried out with rigorous computational setting called the method of lines. At first the dispersion of fundamental modes in an asymmetric strip waveguide with isotropic substrate is obtained and the results are compared with the standard results. Then, to analyze the effect of anisotropy on mode propagation, an asymmetric strip waveguide with anisotropic dielectric substrate is considered. Both uniaxial and biaxial materials are considered as the substrates in this study. Variation of phase and attenuation constants with metal film thickness for each of the four modes is obtained for all the cases under study. The effect of anisotropy, material parameters, and the geometry of the waveguide structure on the dispersion of the fundamental modes is discussed in detail.

Biography

Vincent Mathew did M.Sc. (Physics) from Mahatma Gandhi University, Kerala, India and received PhD from University of Delhi (1998) for his work on inhomogeneous waveguide structures. He had been a Research Fellow at IIT Kanpur during 1991 to 1993. Sponsored by the Indian National Science Academy he visited University of Pecs, Hungary (2007) in an International Exchange Program. He had been an Assistant Professor of Physics at St. Thomas College Palaifrom 2002 to 2011 and he joined the Central University of Kerala, Kasaragodin 2011 as Associate Professor and Head of the Department. His research interests include optical waveguides, plasmonics, quantum transport, and microwave superconductivity.