Opt Quant Electron (2013) 45:481–490
DOI 10.1007/s11082-013-9662-8

Surface plasmon propagation in a metal strip waveguide with biaxial substrate

Anju Babu · C. Bhagyaraj · Jesly Jacob · Gishamol Mathew · Vincent Mathew

Received: 27 October 2012 / Accepted: 5 February 2013 / Published online: 12 February 2013

Abstract Surface plasmon propagation in a nano metal strip waveguide with a biaxial substrate material was studied. The dispersion of the four fundamental modes propagating in the strip waveguide structure was analysed using a formalism based on the method of lines. The propagation properties of these modes with respect to the thickness of the metal film was studied, with two different biaxial materials as substrate for the waveguide. The results were then compared with the asymmetric strip waveguide structures with isotropic substrate and a uniaxial anisotropic substrate. Propagation characteristics as a function of longitudinal and transverse anisotropic components of the substrate material were also studied. The characteristics of the fundamental modes are observed to vary depending on the anisotropy of the biaxial material used.

Keywords Plasmonics · Strip waveguide · Method of lines

1 Introduction

Surface plasmon polaritons (SPPs) are electromagnetic waves that propagate at a metal dielectric interface (Maier 2007). Plasmonic devices have now become an integral part of nanophotonics and by suitably manipulating the waveguide geometries effective plasmonic waveguides with sufficient propagation range are fabricated (Burke et al. 1986; Zia et al. 2004; Gramotnev and Bozhevolnyi 2010). SPP supported by a thin metal film of finite width (metal strip) has been considered as the simplest structure for waveguiding applications. The purely bounded SPP modes guided along a metal strip waveguide is attractive for applications requiring considerable propagation length and two dimensional field confinement (Derigon

A. Babu · C. Bhagyaraj · J. Jacob · G. Mathew
Department of Physics, St. Thomas College, Palai 686574 , Kerala, India

V. Mathew (✉)
Department of Physics, Central University of Kerala, Riverside Transit Campus,
Padennakad P.O., Nileshwar, Kasaragode 671314 , Kerala, India
e-mail: vmresearchgp@gmail.com; vincent@cukerala.edu.in