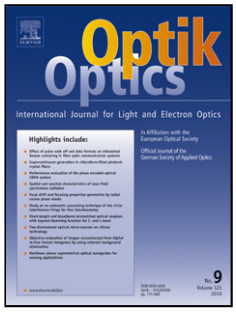

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Circuit Elements at Optical Frequency in Non-integer Dimensional Space

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Abstract

In present discussion, the idea of non-integer dimensional (NID) optoelectronics has been investigated. For this purpose, a nano-size sphere of any material, (plasmonic or non-plasmonic) placed in NID space has been excited by an optical signal. Fields in the presence of sphere have been used to derive impedances. Reactance for the region inside the sphere is independent of NID parameter. Whereas, the capacitive and inductive behavior of impedance for the region outside the sphere can be controlled through material properties and NID parameter. This gives the existence of fringing capacitance and inductance.

1. Introduction

Quasi-static analysis becomes applicable when size of the object or scatterer is very small at the operating frequency[1,2]. This treatment may be considered as intermediate between the solutions: one obtained from static treatment and other derived using the complete set of Maxwell equations. Recently, quasi-static analysis has gained interest of researchers because of Engheta's work related to the study of nano-size sphere at optical frequency[3]. He deduced that, depending upon the electric properties of the material, sphere at optical frequencies may behave as either a capacitor or an inductor. Non-plasmonic sphere behaves as capacitor whereas plasmonic sphere behaves as inductor. His work motivates for the possibility of combining features of electronics and optics, in other words, the simultaneous achievement of compactness