PHOTONIC CRYSTAL BASED NOVEL AND EFFICIENT DEVICES

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Photonic crystals (also known as photonic band-gap materials) are a relatively new type of functional materials. These are periodic dielectric structures that have a band gap that forbids propagation of a certain frequency range of light. This property enables one to control light with amazing facility and produce effects that are impossible with conventional optics.

Photonic crystal, described by Maxwell's equations, is a periodic optical nanostructure that affects the motion of photons in much the same way that ionic lattices affect electrons in solids, and can be periodic in a single dimension, two dimensions or three dimensions. The periodic nature of the structure causes the dispersion relation (relationship of frequency to wavelength) to be periodic and to have a band structure. The addition of a defect in the otherwise periodic structure adds another dimension in their operation leading to many useful applications in waveguiding and related devices. Photonic crystals have been studied in one form or another since 1887, but no one used the term photonic crystal until over 100 years later—after Eli Yablonovitch and Sajeev John published two milestone papers on photonic crystals in 1987 [1,2]. Since then, this field has generated great interest [3].

In this invited talk, I will discuss about some fundamentals of photonic crystal so as to build a background for a few interesting applications we are working on. These applications include the generation and manipulation of slow light for obtaining compact optical devices using photonic crystals. Also, a novel application of photonic crystals in thin film solar cells to enhance their efficiency will be demonstrated, which has been realized by our research group through design and fabrication. The fabrication process, materials involved and the issues faced in realizing these complex structures will also be addressed [4-6].

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