Design and modeling of a novel two dimensional nano-scaled force sensor based on silicon photonic crystal

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Photonic crystal, which is an attractive optical structure for controlling and manipulating the flow of light, has been widely used to design mechanical sensors in microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS). The mechanical sensors based on photonic crystal are extremely sensitive to a small refractive index change produced by deformation, force and pressure. Thus, the principle of the sensor is that the output wavelength of the mechanical sensor using photonic crystal varies as a function of deformation, force and pressure, respectively. In this work, a novel two dimension nano-scaled force sensor based on silicon photonic crystal, in which a nanocavity is embedded in an L-shaped microcantilever, is developed and studied numerically. The relationship between the force and the output wavelength is determineded using finite element method and finite difference time-domain method. The effect of the nanocavity geometry and material properties of photonic crystal are investigated.