Scanning near field optical spectroscopy with light tunnelling control

Chiara Vecchi

Photonic crystal nanocavities are objects that can create light confinement in a volume of $(\frac{\lambda}{n})^3$. Theese objects have many applications, for istance they may be used to build sensors or to study quantum electrodynamics effects. Photonic crystals have lot of similarities with natural crystals since there is a periodic modulation of the dielectric constant which is the same of the periodic modulation of the potential. Therefore, the electromagnetic field plays the role of the electronic wavefunction in quantum mechanics. Theese photonic crystals can be studied using Bloch formalism in order to obtain a band stucture for photons. It is also possible to observe a gap of forbidden frequencies between bands. A localized defect inside a photonic crystal would be similar to a cavity as it would introduce some wavelenghts which are forbidden in the other parts of the crystal. If two identical cavities are placed next to each other and there is a spatial superposition between electromagnetic fields, we obtain that the mode of single cavity is splitted in two new modes which can be seen as the bounding and antibounding states of a diatomic molecule. This work prooved that even if two cavities are very spatially separated, the above-mentioned effect is observable thanks to a new innovative design. This new design is useful in order to study the tunneling of light between cavities.