On demand dispersion characteristics in High index contrast/Photonic Crystal dielectric gratings with transverse broken symmetry

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Inside the wide family of periodic photonic structures, High index Contrast / Photonic Crystal dielectric Gratings (HC/PC-G) have played a fast growing part during the last 25 years, their specificity inherently lying in the index contrast of the periodic modulation introduced in the optical medium, which is generally in excess of 200%. Apart from rare exceptions, reports in the literature are essentially dedicated to HC/PC-G with non-broken transverse symmetry. In the present contribution we emphasize that breaking the transverse symmetry of HC/PC-G provides a widely enhanced degree of freedom for the design of dispersion characteristics, and hence for the control of spatial routes and spectral characteristics of light, which depends, to an essential extent, on the local density of photonic states in the thin nano-structured dielectric film. We show that, with this simple design joystick, one can generate any local density of photonic states from zero (Dirac cone) to infinity (ultra-flat zero curvature dispersion characteristics), as well as any constant density over an adjustable spectral range.

The talk will start with the presentation of theoretical concepts based on coupled mode formalism, which ends up with a physical / phenomenological Hamiltonian description of optical mode interactions. With this approach, physically insightful analytical model of dispersion characteristics is derived and confronted with numerical simulations, in selected illustrating examples. Finally, we exemplify the great potential of this family of asymmetric HC/PC-G, as generic building blocks for a range of new practical applications as well as for original physical studies.