Controlling Light in Transformation Optical Waveguides

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Hui Liu

Nanjing University

Various transformational devices and effects based on inhomogeneous metamaterials have been proposed, such as invisibility cloaks [1-2], photonic black holes [3], etc. Different approaches are invented to realize transformation optics. Recently, the speaker and his research group apply inhomogenous waveguide to transformation optical effects, such as mimicking gravitational lensing [4] and bending light beam [5]. In this talk, the speaker proposes an enhanced photothermal effect facilitated by a Fabry-Perot (FP) cavity to achieve light-controllable transformation optics devices. A planar silver/PMMA/silver FP cavity is fabricated. In the experiment, a Gaussian pump laser beam is incident normally on the cavity and induces a change in the refractive index of PMMA layer due to thermal heating. A probe laser beam with wavelength of 457nm is coupled into the silver/PMMA/silver waveguide through a grating. The structure can be seen as a transformation optical lens. The refractive index is spatially continuously changed and the light beam is bending continuously at different locations. As the refractive index is non-uniform, the bending angle of light beam will be quite different for different input light beam. Here, the distance between the light beam and the center of lens can be defined as impact parameter distance r_0. In the experiment, light beam is continuously moved from a distance to the center of lens through changing the location of laser spot of 457nm laser on the grating. The results show, for different r_0, different trajectory of light beam can be obtained around the transformation lens. This work reported a flexible method to fabrication transformation optical media. The refractive index of the polymer inside the cavity is inhomogeneously changed. This is used to change the trajectory of light beam inside the polymer layer. Such a method can be extended to fabricate many other transformation optical medium. All such potential expansibility of this system provide new ways to develop various multifunctional transformation devices in the future.

References:

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