**Optically reconfigurable all-dielectric metamaterial and photonic devices**

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Metamaterials and photonic components with tunable and switchable properties upon stimulations have excited great interests as the next stage of the photonics technological revolution for dynamically control of optical properties ‘on demand’. Their numerous useful applications range from adaptive optics, dynamic optical modulator and filters, to reconfigurable meta-devices in broadband frequency. Specifically, all-dielectric architecture offers an innovative opportunity to realize dynamically controllable meta-devices free from the high ohmic losses inherent to noble metal frameworks. In this work, we pioneered the field of dielectric metamaterial platform for reconfigurable photonic components and metamaterials in a non-volatile and reversible fashion based on phase change materials, chalcogenide glasses. Such materials can undertake a large number of phase transition cycles with huge optical properties difference between amorphous and crystalline states, forming a major advantage in realization of reconfigurable photonic devices. Different from conventional one-step optical switch of chalcogenide glass in data storage technique, we used controllable femtosecond laser pulse trains to induce gradual switch for multi-level phase change. Aided with high resolution optically writing process, we demonstrated various photonic devices, from Fresnel zone pates, super-oscillatory lens, grayscale hologram to reconfigurable multi-focus photonic components by optically writing, erasing and re-writing patterns onto a phase change thin film. Notably, a dipolar dielectric metamatrial with on-demand refection and transmission resonances is demonstrated by pulse trains to generate crystalline inclusions in the amorphous chalcogenide glass film. With the directly-written capability, photonic components can be designed and completely changed at will to bring totally different optical properties, paving a novel way for reconfigurable photonic device applications.