Phase-change Nanophotonics

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Phase-change materials, including metals, semiconductors and liquid crystals, have played a key role in the evolution of active nanophotonic and plasmonic functionalities. They present unique opportunities at the nano- (i.e. subwavelength) scale as a source of optical nonlinearity and a platform for high-contrast, low-energy electro- and all-optical switching/memory devices. I will review Southampton's work in this field: from the demonstration of exceptionally large (including metamaterial-enhanced) phase-change nonlinearities underpinned by light-induced, surface-mediated structural transitions in confined gallium; through the harnessing of non-volatile optically-induced amorphous/crystalline transitions in chalcogenides (such as Ge:Sb:Te) to realize plasmonic hybrid and all-dielectric switchable and laser re-writable metasurfaces; to the recent revelation that germanium and bismuth-based chalcogenide alloys can themselves present switchable and compositionally-tunable plasmonic properties in the UV-VIS spectral range.