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# Self-assembly routes to metamaterials and nanostructures for photonics

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Metamaterials and metasurfaces rely on optically resonant nanostructures for the control and manipulation of light. Plasmons at metal/dielectrics interfaces provide strong resonances, which has encouraged, in the recent years, active research efforts towards the fabrication of nanostructured metal-dielectric materials and surfaces. Most nanoplasmonic metamaterials have been built by lithographic approaches using microelectronics technologies. This has enabled the fabrication of a large number of electromagnetic metamaterials operating at frequencies down to the ultraviolet. However these top-down approaches, though very precise in making ordered structures, are highly cost-, time- and energy-intensive, especially for sub-100nm resonator sizes (for visible wavelengths), so that materials are usually restricted to very small lateral dimensions and thicknesses. Alternative fabrication methodologies have been developed based on colloidal chemistry, self- and directed-assembly and soft matter physics. We will discuss some recent studies, which led to the fabrication of 2D or 3D dense assemblies of resonators presenting hyperbolic permittivities, optical magnetism or forward cattering of light. Self-assembly based methodologies present interesting perspectives both for the production of individual optically resonating colloids in large numbers, and for their assembly into large scale materials and surfaces.