What is claimed is:

1. An element configured to be used in a light exposure system, wherein the element interacts with one or more desired wavelengths between 0.1 nm and 250 nm, the element comprising a coating:

wherein the coating comprises a stack of two or more layers;

wherein at least two layers each comprise a plurality of nanostructured features arranged in one or more directions wherein at least one direction is orthogonal to the stack axis and having a size range of between 250 nm and 0.01nm;

wherein the plurality of nanostructured features are configured to:

A) improve the reflectivity of the element to greater than 70% for the desired wavelengths, or

B) improve the transmission of the element to greater than 4% for [a] the desired wavelengths, or

C) control the electromagnetic radiation absorption for [a] the desired wavelengths, wherein the plurality of nanostructured features are configured to reduce or increase the bulk electromagnetic absorption.

2. An element configured to be used in a light exposure system, wherein the element interacts with one or more desired wavelengths between 0.1 nm and 250 nm, the element comprising a coating:

wherein the coating comprises an assembled stack of building blocks stacked in two or more dimensions, wherein each building block is a nanostructured feature having a size range of between 250 nm and 0.01 nm;

wherein the coating further comprises a configuration of one or more different materials, the combination of materials forming a photonic or plasmonic crystal, or a metamaterial;

wherein the plurality of nanostructured features are configured to:

A) improve the reflectivity of the element to greater than 70% for the desired wavelengths, or

B) improve the transmission of the element to greater than 4% for [a] the desired wavelengths, or

C) control the electromagnetic radiation absorption for [a] the desired wavelengths, wherein the plurality of nanostructured features are configured to reduce or increase the bulk electromagnetic absorption.

3. The light exposure system according to claims 1 or 2 where the system includes a photolithography tool, biotechnology system, scanning or imaging system, astronomical system, general materials processing system or a printing system.

4. The element according to claims 1 or 2, wherein the plurality of nanostructured features having a first size, said first size substantially correlating with the desired wavelengths.

5. The element according to claims 1 or 2, wherein the plurality of nanostructured features or the layers are one-, two-, or three-dimensional.

6. The element according to claims 1 or 2, wherein the plurality of nanostructured features or the layers have a periodicity, said periodicity may be in one, two, or three dimensions.

7. The element according to claims 1 or 2, wherein the plurality of nanostructured features are arranged in one of the following: semi-periodic, aperiodic, quasi-periodic, graded, partially graded, symmetric, fractal, gyroid, swiss roll, non-planar, segments, repeated unit, forming a pattern, or randomly or semi random order in the coating.

8. The element according to claims 1 or 2, wherein the layers or the nanostructured feature is selected from one or more of the following: metal, dielectric, gas, liquid, compound, semiconductor, polymer, organic material, biological material, monatomic material, air, Carbon, Molybdenum, Beryllium, Lanthanum, Boron Carbide, Silicon, SiO_2, TiO_2, Ruthenium, Niobium, Rhodium, Gold, Silver, Copper, Platinum, Palladium, Germanium, DNA, proteins, graphene, graphite, carbon nanotubes, MoS, O_2, N_2, He, H_2, Ar, CO_2.

9. The element according to claims 1 or 2, wherein the element is selected from a substrate, mirror, lens, surface, window, facet, filter, covering element, capping layer, protective layer, barrier layer, thin film, coating, internal surface area, collector, droplet generator, interdispersed material, panel, waveguide, cavity, fiber, structural component, reflective element, transmissive element, a detector, a wavelength monitor, bandwidth or power monitor, sensors, a photomask, photoresist, a cooling mechanism, a heat management mechanism, light source, lamp, laser, optical element, mask aligner, integrator, structural component, optical device, or an electrical device.

10. The element according to claims 1 or 2, wherein the nanostructured feature has a shape or dimension containing layers, films, spheres, blocks, pyramids, rings, porous structures, voids, cylinders, gyroids, linked shapes, shells, freeform shapes, chiral structures, hemispheres or segments.

11. The element according to claims 1 or 2, wherein the layers or the nanostructured features or subset of the coating or aspect of the coating is fabricated by one of the following methods of processing: self-assembly, directed assembly, soft templating, electroforming, electroplating, sacrificial or scaffolding materials, block co-polymers, bottom-up techniques, EUV or XUV lithography, focused electron or ion beams, nanoimprinting, atomic force or scanning probe microscopy, two or more photon lithography, laser irradiation, dealloying, chemical etching, chemical surfactants, surface treatments.