What is claimed is:

1. An optical element constructed for use with electromagnetic radiation at a specific target wavelength that is between 0.1 nm and 250 nm, comprising:

a reflective, transmissive, protective, interdispersed or capping layer coating;

wherein the coating comprises one or more materials where at least one of the materials includes a monatomic material;

wherein the monatomic material is arranged into one or more stacked layers, each layer of the monatomic material having a single unit atomic thickness in one physical dimension and extending in two other dimensions; and

wherein the electromagnetic response of the coating is resonant at the specific target wavelength that is between 0.1 nm and 250 nm.

2. The optical element according to claim 1, wherein at least one of the stacked layers is graphene, graphite or carbon nanotubes.

3. The optical element according to claim 1, wherein the reflective coating is multilayer and at least one material is graphene.

4. The optical element according to claim 1, wherein the reflective coating has at least one of the materials as molybdenum.

5. The optical element according to claim 1, wherein the transmissive coating or layer has at least one material that is graphene.

6. The optical element according to claim 1, wherein the optical element may be one or more of the following elements: a substrate, mirror, lens, surface, window, facet, filter, covering element, capping layer, protective layer, barrier layer, thin film, membrane, partially supported, free standing structure, 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, mask aligner, integrator, structural component, optical device, or an electrical device.

7. The optical element according to claim 1, wherein the optical element has a reflectivity greater than 70% or a transmissivity of greater than 4% for the optical element.

8. An optical element constructed for use with electromagnetic radiation at a specific target wavelength that is between 0.1 nm and 250 nm, comprising:

a coating, the coating comprising a configuration of one or more different materials, the combination of materials forming a photonic or plasmonic crystal, or a metamaterial; and

wherein the materials are arranged to increase or decrease the electromagnetic interaction at the specific target wavelength that is between 0.1 nm and 250 nm.

9. The optical element according to claim 8, wherein the coating materials form the photonic crystal, and the photonic crystal has a photonic bandgap, and produces a reflectance with a resonance at the specific target wavelength.

10. The optical element according to claim 9, wherein the materials are configured to produce a reflectivity higher than that from a molybdenum/silicon multilayer.

11. The optical element according to claim 8, wherein the specific target wavelength is at a target wavelength of about 13.5 nanometers.

12. The optical element according to claim 8, wherein the optical element may be one or more of the following elements: a substrate, mirror, lens, surface, window, facet, filter, covering element, capping layer, protective layer, barrier layer, thin film, membrane, partially supported structure, free standing structure, 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, mask aligner, integrator, optical device, or an electrical device.

13. The optical element according to claim 8 wherein at least one of the materials has a plurality of nanoscale structural features, which may be semi-periodic, aperiodic, quasi-periodic, crystalline, graded, random or partially graded in the bulk material.

14. The optical element according to claim 13, wherein the nanoscale structural features are constructed as spheres, blocks, pyramids, rings, cylinders, linked shapes, shells, freeform shapes, gyroids, chiral structures, hemispheres or segments.

15. The optical element according to claim 8, wherein the crystal has a periodicity of one, two, or three dimensions.

16. The optical element of claim 8 wherein the plasmonic crystal is used to absorb light at the specific target wavelength.

17. The optical element according to claim 8 wherein the material is fabricated by one of the following methods of processing: self-assembly, directed assembly, soft templating, electroforming, electrodeposition, 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.

18. The optical element according to claim 8, wherein the materials include: metal, dielectric, gas, liquid, compound, semiconductor, polymer, organic material, biological material, monatomic material, air, Carbon, Molybdenum, Beryllium, Lanthanum, Boron Carbide, Silicon, SiO.sub.2, TiO.sub.2, Ruthenium, Niobium, Rhodium, Gold, Silver, Copper, Platinum, Palladium, Germanium, DNA, proteins, graphene, graphite, carbon nanotubes, MoS, O.sub.2, N.sub.2, He, H2, Ar, or CO.sub.2.

19. The optical element according to claim 8 wherein the plasmonic crystal controls the phase, polarization, spectral bandwidth, angular acceptance range, or polarization of the incident radiation.

20. The optical element according to claim 8, wherein the one or more materials of the coating are configured to reflect, absorb, or transmit electromagnetic radiation at the specific target wavelength in the UV, EUV or soft X-ray bands, and the materials are fabricated using a method comprising:

polishing a host layer or substrate;

assembling a polymeric or scaffolding or sacrificial structure;

growing a main layer over or through the scaffolding structure; and removing the polymeric or scaffolding or sacrificial structure.

21. The optical element according to claim 20 wherein the optical element may be one or more of the following elements: 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.

22. The optical element according claim 20 wherein the main layer is selected from one or more of the following materials: metal, dielectric, gas, liquid, compound, semiconductor, polymer, organic material, biological material, monatomic material, air, Carbon, Molybdenum, Beryllium, Lanthanum, Boron Carbide, Silicon, SiO.sub.2, TiO.sub.2, Ruthenium, Niobium, Rhodium, Gold, Silver, Copper, Platinum, Palladium, Germanium, DNA, proteins, graphene, graphite, carbon nanotubes, MoS, O.sub.2, N.sub.2, He, H.sub.2, Ar, CO.sub.2.

23. The optical element according to claim 8, wherein the photonic crystal controls the phase, polarization, spectral bandwidth, angular acceptance range, or polarization of the incident radiation.

24. The optical element according to claim 8, wherein the optical element has a reflectivity greater than 70% or a transmissivity of greater than 4% for the optical element.

25. An optical element constructed for use with electromagnetic radiation at a specific target wavelength that is between 0.1 nm and 250 nm, comprising:

a reflective, transmissive, protective, interdispersed or capping layer coating; and

wherein the coating comprises one or more materials where at least one of the materials is a two-dimensional, atomic scale material with a spatial arrangement of atoms in a lattice; and

wherein the electromagnetic response of the coating is resonant at the specific target wavelength that is between 0.1 nm and 250 nm.

26. The optical element according to claim 25, wherein the two-dimensional material is a molybdenum based compound or graphene.

27. The optical element according to claim 25, wherein the optical element has a reflectivity greater than 70% or a transmissivity of greater than 4% for the optical element.