CLAIMS:

1. An analyte detection device comprising:

a plurality of detection conjugates, wherein the conjugates comprise composite metallic nanostructures coupled to binding partners that are capable of specifically binding to a target analyte, wherein the composite metallic nanostructures comprise a silver core and a gold coating;

a surface containing a metallic nanolayer; and

a plurality of capture molecules, wherein the capture molecules are immobilized on the metallic nanolayer and are capable of specifically binding to the target analyte.

2. An analyte detection device comprising:

a plurality of detection conjugates, wherein the conjugates comprise composite metallic nanostructures coupled to target analytes, wherein the composite metallic nanostructures comprise a silver core and a gold coating;

a surface containing a metallic nanolayer; and

a plurality of capture molecules, wherein the capture molecules are immobilized on the metallic nanolayer and are capable of specifically binding to the target analytes.

3. The analyte detection device of claim 1 ~~or 2, wherein the composite metallic nanostructures comprise at least two metals selected from gold, silver, copper, platinum, palladium, cadmium, iron, nickel, and zinc.~~

~~4. The analyte detection device of claim 1 or 2, wherein each of the composite metallic nanostructures comprises a core of a first metal and a coating of a second metal.~~

~~5. The analyte detection device of claim 4, wherein each of the composite metallic nanostructures comprises a gold coating and a sliver core.~~

~~6. The analyte detection device of claim 1 or 2, wherein each of the composite metallic nanostructures is an alloy of a first metal and a second metal.~~

~~7. The analyte detection device of claim 1 or 2~~, wherein the composite metallic nanostructures are spherical nanoparticles and have a diameter of about 5 nm to about 200 nm.

~~8.~~ 4. The analyte detection device of claim 1~~ or 2~~, wherein the composite metallic nanostructures are spherical nanoparticles and have a diameter of about 10 nm to about 100 nm.

~~9.~~ 5. The analyte detection device of claim 1~~ or 2~~, wherein the composite metallic nanostructures are nanoplates with an edge length of about 10 nm to about 800 nm and a thickness of about 1 nm to about 100 nm.

~~10.~~ 6. The analyte detection device of claim 1~~ or 2~~, wherein the plurality of detection conjugates is in the form of a lyophilized pellet or bead.

~~11.~~ 7. The analyte detection device of claim 1~~ or 2~~, wherein the surface is a chip, a well, a bead, or a wall, cover, and/or bottom of a cuvette.

~~12.~~ 8. The analyte detection device of claim 1~~ or 2~~, wherein the metallic nanolayer is a metallic film.

~~13.~~ 9. The analyte detection device of claim ~~12~~8, wherein the metallic film comprises gold, silver, copper, platinum, palladium, cadmium, zinc or a composite thereof.

~~14.~~ 10. The analyte detection device of claim ~~12~~8, wherein the metallic film comprises gold.

~~15.~~ 11. The analyte detection device of claim 1~~ or 2~~, wherein the metallic nanolayer comprises a plurality of metallic nanostructures immobilized on the surface.

~~16.~~ 12. The analyte detection device of claim ~~15~~11, wherein the plurality of metallic nanostructures comprise gold, silver, copper, platinum, palladium, cadmium, zinc or a composite thereof.

~~17.~~ 13. The analyte detection device of claim ~~15~~11, wherein the plurality of metallic nanostructures are gold nanostructures.

~~18.~~ 14. The analyte detection device of claim 1~~ or 2~~, wherein the composite nanostructures have a geometry selected from spherical nanoparticles, pyramidal nanoparticles, hexagonal nanoparticles, nanoshells, nanotubes, nanorods, nanodots, nanoislands, nanowires, or combinations thereof.

~~19.~~ 15. The analyte detection device of claim 1, wherein the binding partners and/or capture molecules are antibodies, antigens, polypeptides, polynucleotides, nucleoproteins, aptamers, ligands, receptors, or haptens.

~~20.~~ 16. The analyte detection device of claim 1, wherein the binding partners are antibodies that recognize a first epitope of a target analyte and the capture molecules are different antibodies that recognize a second epitope of a target analyte.

~~21.~~ 17. The analyte detection device of claim 2, wherein the capture molecules are antibodies, antigens, polypeptides, polynucleotides, nucleoproteins, aptamers, ligands, receptors, or haptens.

~~22.~~ 18. The analyte detection device of claim 1~~ or 2~~, wherein the target analyte is a marker or antigen associated with an infectious disease, physiological state, or pathological condition.

~~23.~~ 19. The analyte detection device of claim 1~~ or 2~~, wherein the target analyte is canine heartworm, feline leukemia virus, canine parvovirus, C-reactive protein, *Giardia lamblia, Ehrlichia* antigen or antibody, *Borrelia* antigen or antibody, *Anaplasma* antigen or antibody, a cancer antigen, a cardiac marker antigen, thyroid stimulating hormone, thyroxine, troponin, or brain natriuretic peptide.

~~24.~~ 20. A method of detecting a target analyte in a sample comprising:

mixing the sample with a plurality of detection conjugates, wherein the conjugates comprise composite metallic nanostructures coupled to binding partners that are capable of specifically binding to the target analyte if present in the sample to form analyte-detection

conjugate complexes, wherein the composite metallic nanostructures comprise a silver core and a gold coating;

contacting the mixture with a surface containing a metallic nanolayer, wherein a plurality of capture molecules are immobilized on the metallic nanolayer and are capable of specifically binding to the target analyte if present in the sample;

exposing the surface to a light source at a wavelength range within the ultraviolet-visible-infrared spectrum; and

measuring an optical signal from the surface, wherein a change in the optical signal indicates the presence of the target analyte in the sample.

~~25.~~ 21. The method of claim ~~24~~20, wherein the optical signal is reflectance, an absorbance spectrum, scattering spectrum, or an emission spectrum.

~~26.~~ 22. The method of claim ~~24~~20, wherein the change in the optical signal comprises a spectral peak wavelength shift.

~~27.~~ 23. The method of claim ~~24~~20, wherein the presence of nanogram quantities of the target analyte is detected.

~~28.~~ 24. The method of claim ~~24~~20, wherein the presence of picogram quantities of the target analyte is detected.

~~29.~~ 25. The method of claim ~~24~~20, wherein the presence of femtogram quantities of the target analyte is detected.

~~30.~~ 26. The method of claim ~~24~~20, wherein the surface is the walls and bottom of a cuvette incorporated into a centrifugal rotor.

~~31.~~ 27. The method of claim ~~24, wherein the composite metallic nanostructures comprise at least two metals selected from gold, silver, copper, platinum, palladium, cadmium, iron, nickel, and zinc.~~

~~32. The method of claim 24, wherein each of the composite metallic nanostructures comprises a core of a first metal and a coating of a second metal.~~

~~33. The method of claim 32, wherein each of the composite metallic nanostructures comprises a gold coating and a sliver core.~~

~~34. The method of claim 24, wherein each of the composite metallic nanostructures is an alloy of a first metal and a second metal.~~

~~35. The method of claim 24~~20, wherein the metallic nanolayer is a metallic film.

~~36.~~ 28. The method of claim ~~35~~27, wherein the metallic film comprises gold.

~~37.~~ 29. The method of claim ~~24~~20, wherein the metallic nanolayer comprises a plurality of metallic nanostructures immobilized on the surface.

~~38.~~ 30. The method of claim ~~37~~29, wherein the plurality of metallic nanostructures are gold nanostructures.

~~39.~~ 31. The method of claim ~~24~~20, wherein the composite nanostructures have a geometry selected from spherical nanoparticles, pyramidal nanoparticles, hexagonal nanoparticles, nanotubes, nanoshells, nanorods, nanoislands, nanodots, nanowires, or combinations thereof.

~~40. A method for preparing composite metallic nanostructures comprising:~~

~~preparing a first solution comprising a mixture of a polymer and chloroauric acid;~~

~~preparing a second solution comprising silver or copper nanostructures; and~~

~~incubating the first solution with the second solution for a period of time, wherein the resulting mixture comprises gold-coated silver nanostructures or gold-coated copper nanostructures.~~

~~41. The method of claim 40, wherein the second solution comprises silver nanostructures and has a peak absorbance of about 550 to 750 nm.~~

42. The method of claim 40, wherein the polymer is polyvinylpyrrolidone, polyvinyl alcohol, polyacrylate, polyethylene glycol or polyethyleneimine.

43. An assay complex comprising:

a detection conjugate comprising a composite metallic nanostructure coupled to a binding partner;

a target analyte; and

a metallic nanolayer-coated bead on which a capture molecule is immobilized, wherein the binding partner in the detection conjugate is bound to a first epitope on the target analyte and the capture molecule is bound to a second epitope on the target analyte, thereby forming a complex comprising the detection conjugate, target analyte, and the capture molecule.

44. The assay complex of claim 43, wherein the binding partner is an antibody and the capture molecule is a different antibody.

45. The assay complex of claim 43, wherein the metallic nanolayer is a metallic film.

46. The assay complex of claim 45, wherein the metallic film comprises gold, silver, copper, platinum, palladium, cadmium, zinc or a composite thereof.

47. The assay complex of claim 46, wherein the metallic film comprises gold.

48. The assay complex of claim 43, wherein the metallic nanolayer comprises a plurality of metallic nanostructures immobilized on the bead.

49. The assay complex of claim 48, wherein the plurality of metallic nanostructures comprise gold, silver, copper, platinum, palladium, cadmium, zinc or a composite thereof.

50. The assay complex of claim 49, wherein the plurality of metallic nanostructures are gold nanostructures.

51. The assay complex of claim 43, wherein the composite metallic nanostructure comprises at least two metals selected from gold, silver, copper, platinum, palladium, cadmium, iron, nickel, and zinc.

~~52. The assay complex of claim 43, wherein the composite metallic nanostructure comprises a core of a first metal and a coating of a second metal.~~

~~53. The assay complex of claim 43, wherein the composite metallic nanostructure comprises a gold coating and a sliver core.~~

~~54. The assay complex of claim 43, wherein the composite metallic nanostructure is an alloy of a first metal and a second metal.~~