CLAIMS

1. A surface-enhanced Raman scattering (SERS) chip for generating multiple SERS profiles simultaneously from one or more analytes suspected to be in a sample, the SERS chip comprising:

one or more substrates; and

one or more Raman probes formed on the one or more substrates,

wherein each of the one or more Raman probes comprises a SERS-active nanoparticle grafted with a receptor molecule,

(i) wherein the receptor molecule on each of the one or more Raman probes on one substrate is different from the receptor molecule of the one or more Raman probes on another substrate, and/or (ii) wherein the one or more Raman probes comprise two or more Raman probes and wherein the receptor molecule on each of the two or more Raman probes on one substrate is different,

wherein the receptor molecule comprises a thiol group proximal to the SERS-active nanoparticle and a functional group distal to the SERS-active nanoparticle,

wherein the functional group interacts with the one or more analytes to induce a change in molecular vibration of the receptor molecule which is identifiable by surface-enhanced Raman scattering for generating the multiple SERS profiles,

wherein the SERS-active nanoparticle comprises a nanopolyhedra, and

wherein the receptor molecule comprises 4-mercaptopyridine, 4-aminodiphenyl disulfide, aminothiophenol, mercaptobenzoic acid, naphthalenethiol, mercaptophenylboronic acid, p-methylthiolbenzaldehyde, or bromothiophenol.

2. The surface-enhanced Raman scattering (SERS) chip of claim 1, further comprising a SERS-active nanoparticle, which is absent of the receptor molecule, formed on the one or more substrates.

3. The surface-enhanced Raman scattering (SERS) chip of claim 1 or 2, wherein the SERS-active nanoparticle comprises gold, silver, platinum, or palladium.

4. The surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 3, wherein the SERS-active nanoparticle further comprises a nanosphere, a nanowire, a nanorod, a nanobowl, or a nanoplate.

5. The surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 4, wherein the SERS-active nanoparticle is porous or non-porous.

6. The surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 5, wherein the receptor molecule comprises an aromatic thiol or an alkanethiol.

7. The surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 6, wherein the functional group comprises an amine, a boron, a hydroxyl, a carboxyl, a carbonyl, a phenyl, a pyridyl, a halogen, or a naphthalene.

8. The surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 7, wherein the one or more substrates comprise aluminum or silicon.

9. A method of identifying one or more analytes suspected to be in a sample, the method comprising:

contacting the surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 8 with a sample suspected to contain the one or more analytes;

collecting SERS signals from the surface-enhanced Raman scattering (SERS) chip which has contacted the sample;

constructing a combined-SERS profile from the SERS signals; and

providing the combined-SERS profile to a device configured with a model trained to identify the one or more analytes from the combined-SERS profile.

10. The method of claim 9, wherein collecting the SERS signals comprises:

introducing the surface-enhanced Raman scattering (SERS) chip which has contacted the sample to a laser to generate the SERS signals; and

collecting the SERS signals through a sensor.

11. The method of claim 9 or 10, wherein constructing the combined-SERS profile comprises:

(i) selecting a spectral range for a SERS signal;

(ii) attributing the SERS signal to a receptor molecule which has undergone a change in molecular vibration; and

repeating (i) and (ii) for another receptor molecule to generate multiple SERS profiles from each respective receptor molecule.

12. The method of claim 11, wherein constructing the combined-SERS profile comprises:

connecting the multiple SERS profiles for each respective receptor molecule to form a continuous SERS spectrum as the combined-SERS profile; or

adding the multiple SERS profiles within the spectral range selected to form an intensity-amplified SERS spectrum as the combined-SERS profile.

13. The method of claim 12, wherein connecting the multiple SERS profiles to form the combined-SERS profile comprises:

arranging one SERS profile for one respective receptor molecule as a first SERS profile;

adding a constant value to a second SERS profile for the one respective receptor molecule; and

arranging the second SERS profile contiguously after the first SERS profile for forming the continuous SERS spectrum.

14. The method of any one of claims 9 to 13, wherein providing the combined-SERS profile to the device comprises:

generating several of the combined-SERS profile for providing to the device; and

training the device with the several combined-SERS profiles to update the model to identify the one or more analytes.

15. The method of any one of claims 9 to 14, further comprising subjecting the combined-SERS profile to chemometric analysis.

16. A device comprising the surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 8 for use in identifying:

one or more analytes in a gas and/or a liquid; and/or

a subject infected with coronavirus disease.

17. Use of the surface-enhanced Raman scattering (SERS) chip of any one of claims 1 to 8 in the manufacture of a device for identifying:

one or more analytes in a gas and/or a liquid; and/or

a subject infected with coronavirus disease.