CLAIMS

1. A system operable to identify and sort materials of different plastics, the system comprising:

an illumination module operable to emit light at materials of different plastics, wherein the illumination module comprises a hyperspectral optical source and a thermal excitation source, wherein the hyperspectral optical source is operable to emit light ranging from ultraviolet light to infrared light;

an imaging module comprising a hyperspectral detector and a thermal imaging camera each configured to detect light from the illumination module reflected by the materials of different plastics, wherein the hyperspectral detector is operable to convert detected light into hyperspectral signal and the thermal imaging camera is operable to convert detected light into thermal image; and

a data acquisition module comprising a hyperspectral signal processing unit and a thermal signal processing unit, wherein the hyperspectral signal processing unit is operable to generate hyperspectral data from the hyperspectral signal and the thermal signal processing unit is operable to generate thermal imaging data from the thermal image, wherein the materials of different plastics are identifiable from the hyperspectral data and the thermal imaging data.

2. The system of claim 1, wherein the hyperspectral optical source is operable to emit light having a wavelength of 350 nm to 5000 nm.

3. The system of claim 1 or 2, wherein the thermal excitation source comprises one or more light sources, wherein the one or more light sources comprise halogen lamps or are operable to project light comparable to natural sunlight.

4. The system of any one of claims 1 to 3, wherein the hyperspectral detector is operable to detect light having a wavelength of at least 400 nm reflected by the materials of different plastics.

5. The system of any one of claims 1 to 4, wherein the hyperspectral optical source, the thermal excitation source, the hyperspectral detector and the thermal imaging camera, remain stationary during operation.

6. The system of any one of claims 1 to 5, further comprising a machine learning module trainable to identify the materials of different plastics and have the conveyer module categorize the materials of different plastics for sorting.

7. A system operable to identify and sort materials of different plastics, the system comprising:

an illumination module operable to emit light at materials of different plastics, wherein the illumination module comprises a terahertz infrared broadband emission source operable to emit light;

an imaging module comprising a terahertz infrared detector coupled to a prism, wherein the prism is positioned to contact each of the materials in the absence of any force exerted on the prism and the materials to render the contact, wherein the terahertz infrared detector is configured to detect light from the illumination module reflected by the materials of different plastics, wherein the terahertz infrared detector is operable to convert detected light into terahertz signal, wherein the prism renders attenuated total reflection; and

a data acquisition module comprising a terahertz signal processing unit operable to generate a time domain data from the terahertz signal, wherein the materials of different plastics are identifiable from one or more properties of the materials of different plastics calculated using the time domain data.

8. The system of claim 7, wherein the terahertz infrared broadband emission source is operable to emit light having a frequency of 0.1 THz to 10 THz.

9. The system of claim 7 or 8, wherein the prism comprises silicon, sapphire, Teflon, and/or polypropylene.

10. The system of any one of claims 7 to 9, wherein the prism has a resistivity of 7 kΩ-cm or more.

11. The system of any one of claims 7 to 10, wherein the prism is positioned in a path which the light emitted from the terahertz infrared broadband emission source travels to the materials of different plastics.

12. The system of any one of claims 7 to 11, wherein the data acquisition module is operable to identify a terahertz signal which corresponds to a prism-air interface from the time domain data and discounting the terahertz signal corresponding to the prism-air interface from one or more other terahertz signals to identify one or more terahertz signals respectively corresponding to the materials of different plastics.

13. The system of any one of claims 7 to 12, further comprising:

a conveyer module which conveys the materials of different plastics from one point to another; and

an electronic module operable to continuously adjust the terahertz infrared broadband emission source and the terahertz infrared detector, to a position along the conveyer module for

(i) the terahertz infrared broadband emission source to emit light at one or more of the materials and

(ii) the terahertz infrared detector to detect the light reflected by the materials of different plastics.

14. The system of any one of claims 7 to 13, further comprising a machine learning module trainable to identify the materials of different plastics and have the conveyer module categorize the materials of different plastics for sorting.

15. The system of any one of claims 7 to 14, wherein the one or more properties comprise refractive index of a plastic, absorption coefficient of a plastic, and/or dielectric constant of a plastic.

16. A plastic sorting system comprising the system of claims 1 to 6 and the system of claims 7 to 15.

17. A method of identifying and sorting materials of different plastics, the method comprising:

operating the illumination module in a system of any one of claims 1 to 6 or any one of claims 7 to 15 to emit light at materials of different plastics;

configuring the imaging module in a system of any one of claims 1 to 6 or any one of claims 7 to 15 to detect light from the illumination module reflected by the materials of different plastics; and

having the data acquisition module in a system of any one of claims 1 to 6 generate hyperspectral data and thermal imaging data for identifying the materials of different plastics or having the data acquisition module in a system of any one of claims 7 to 15 generate a time domain data for identifying the materials of different plastics.