

- 30 -

CLAIMS:

1. A sample optic assembly for an optical spectroscopy probe, wherein the sample optic assembly comprises:
 - at least one optical element that is positioned for receiving a substantially
 - 5 collimated excitation light beam and directing light rays towards a sample that is behind an optical window or within a transparent container, the at least one optical element being positioned and having one or more surfaces that are shaped to:
 - project the light rays through the optical window or transparent
 - 10 container to focus the light rays into at least one focal spot or at least one focal line which are at one or more portions of a surface or an interior of the sample;
 - collect resulting scattered light from the sample, and
 - compensate for optical aberrations that are created by the optical
 - 15 window or the transparent container to reduce the size of and/or sharpen the at least one focal spot or the at least one focal line,wherein, the collected resulting scattered light is used by an optical spectroscopy analysis system to measure spectroscopic information about the one or more portions of the sample.
- 20 2. The sample optic assembly of claim 1, wherein the at least one optical element comprises one or more aspheric optical elements.
3. The sample optic assembly of claim 1, wherein the at least one optical element comprises a toroidal optical element, having a first profile along a first axis and a second profile along a second axis where the first and second axes
- 25 are perpendicular to one another and the first and second profiles are different.
4. The sample optic assembly of claim 1, wherein the at least one optical element comprises: (a) one or more spherical optical elements and/or (b) one or more spherically toroidal optical elements.

- 31 -

5. The sample optic assembly of any one of claims 1 to 2, wherein the at least one optical element comprises:
- an aspherical focuser having a focal position; and
 - a spherical optical element with at least one spherical surface that is
- 5 substantially centered upon the focal position of the aspherical focuser, wherein the sample is placed at or near the focal position.
6. The sample optic assembly of claim 5, wherein the spherical optical element comprises a full sphere optical element or a partial sphere optical element.
- 10 7. The sample optic assembly of any of claims 1 to 6, wherein the at least one optical element has at least one surface that is shaped to create a plurality of focal spots, at least one focal line, or at least one focal circle.
8. A sample optic assembly for an optical spectroscopy probe, wherein the sample optic assembly comprises:
- 15 at least one optical element that is positioned for receiving a substantially collimated excitation light beam and directing light rays towards a sample, the at least one optical element being positioned and having one or more surfaces that are shaped to:
- project and focus the light rays to create a plurality of focal spots,
- 20 an array of discrete focal spots, at least one focal line, or at least one focal circle, at one or more portions of a surface or an interior of the sample; and
- collect resulting scattered light from the sample,
- wherein, the collected resulting scattered light is used by an optical
- 25 spectroscopy analysis system to measure spectroscopic information about the one or more portions of the sample.
9. The sample optic assembly of claim 8, wherein the at least one optical element has at least one surface which is spherical, aspherical, cylindrical, acylindrical, toroidal, or axicon.

- 32 -

10. The sample optic assembly of any one of claims 8 to 9, wherein the at least one optical element has at least one profile for creating the focal line with a length that is smaller, substantially the same, or larger than the diameter of the collimated excitation light beam that is received by the at least one optical
5 element prior to transmission to the sample.

11. The sample optic assembly of any one of claims 8 to 9, wherein the at least one optical element comprises at least one lens, at least one mirror, or a combination thereof, that collectively provide a plurality of optical surface regions that are disposed and operate in parallel with one another to focus
10 separate sections of the substantially collimated excitation light beam to simultaneously create the plurality of focal spots, a plurality of focal lines, or a plurality of focal circles that are disposed at the one or more portions of the surface or the interior of the sample.

12. The sample optic assembly of any one of claims 8 to 9, wherein the at least one optical element includes a lenslet array or an array of reflective mirror surfaces that collectively provide a plurality of optical surface regions that are disposed and operate in parallel with one another to create the plurality of focal spots, a plurality of focal lines, or a plurality of focal circles in a pattern including a line, a grid, or other lateral distribution suited to the sample when the sample
15 20 optic assembly receives the substantially collimated excitation light beam.

13. The optical spectroscopy probe of any of claims 11 to 12, wherein the plurality of optical surface regions have different focal lengths or are placed at different positions along the optical axis of the substantially collimated excitation light beam to create the plurality of focal spots at positions that are:
25 (a) at different distances from the probe head and/or (b) at different depths within the sample.

14. The sample optic assembly of any one of claims 8 to 13, wherein the at least one optical element has at least one surface which is adapted to compensate for optical aberrations that are created by an optical window or a

- 33 -

transparent container between the sample optic assembly and the sample, to reduce the size of and/or sharpen the plurality of focal spots, the at least one focal line, or the at least one focal circle.

15. The sample optic assembly of any one of claims 1 to 14, wherein the
5 sample optic assembly is integrated into a flow cell that is adjacent to the at least one optical element and includes a flow assembly that defines a sample channel through which the sample flows and an optical window that is disposed on a surface of the flow cell and adjacent to the sample channel for receiving the at least one focal spot, the at least one focal line, or the at least one focal
10 circle.

16. The sample optic assembly of claim 15, wherein the flow assembly comprises a shallow sample channel portion and the at least one optical element is adapted to generate the plurality of focal spots or the at least one focal line to be substantially parallel or substantially perpendicular to a direction
15 of sample flow and coincident with the shallow sample channel portion.

17. The sample optic assembly of any one of claims 15 to 16, wherein the sample channel has a depth that is smaller than a mean optical scattering path length of the sample.