

CLAIMS

1. A method of laser ablation ~~inductively coupled plasma-mass spectrometry system~~

comprising:

a laser ablation source for generating an ablated plume from a sample;

a laser for emitting a laser beam;

a mirror positioned to reflect the laser beam onto the sample, wherein the mirror includes

an opening; and

an injector gas conduit adapted to couple the laser ablation source with an inductively

coupled plasma (ICP) produced by an ICP torch, wherein said injector gas conduit passes

through the opening of the mirror, wherein the injector gas conduit includes an injector inlet

positioned within the laser ablation source, and wherein the injector inlet is configured for

capturing the ablated plume.

2. The system of claim 1, wherein the injector gas conduit is not bent.

3. The system of claim 1, wherein the laser beam passes through an additional optical

element, and wherein the injector gas conduit passes through an opening of the additional optical

element.

4. The system of claim 3, wherein the additional optical element is an objective lens or

an optical window.

5. The system of claim 1, wherein a diameter of the injector gas conduit is not

constant.

6. The system of claim 5, wherein the injector gas conduit is tapered cytometry analysis.

~~7. The system of claim 1, wherein the injector gas conduit is configured to allow for sacrificial flow.~~

~~8. The system of claim 1, wherein the injector gas conduit is perpendicular to the sample.~~

~~9. The system of claim 1, wherein the laser is a femtosecond laser.~~

~~10. The system of claim 1, wherein the system further comprises a sample cone positioned near a zone where ablation plumes are generated.~~

~~11. The system of claim 10, wherein the system further comprises a carrier gas inlet and an injector gas inlet.~~

~~12. The system of claim 11, wherein the carrier gas inlet and the injector gas inlet are configured to inject different gasses.~~

~~13. A method of using a laser ablation inductively coupled plasma mass spectrometry system~~cytometer, the method comprising:

~~_directing pulses of a laser beam to a plurality of sites of a sample for generating a set of ablated plumes of the sample, wherein directing a pulse of the laser beam comprises reflecting the pulse of the laser beam onto the sample to generate an ablated plume using a mirror having an opening;~~

~~capturing~~of sample for each ~~ablated plume of the set of ablated plumes;~~

~~transferring~~pulses; capturing each ~~of the captured ablated plumes into an inductively coupled plasma~~

~~(ICP), wherein~~plume; transferring each of the captured ablated plumes ~~comprises passing each of the~~

~~captured ablated plumes through the opening of the mirror; and~~

into an inductively coupled plasma (ICP); and ionizing each of the captured and transferred ablated plumes in the ICP;

~~wherein the system comprises:~~

a laser ablation source for generating the set of, thereby generating ions for mass cytometry analysis; wherein the laser ablation mass cytometer comprises an injector adapted to transfer the ablated plumes to the ICP, the injector having an injector inlet positioned within a laser ablation source, the injector inlet being configured for capturing the ablated plumes; wherein the injector inlet forms a sample cone, wherein a narrower portion of the sample cone is an aperture of the injector inlet; wherein the sample cone is positioned adjacent an area where the ablated plume is generated; and wherein the method further comprises introducing a capture gas flow to bring the ablated plumes into the sample cone of the injector and introducing a transfer gas flow, separate from the capture gas flow, into the injector for transferring the ablated plumes from the sample; cone toward the ICP.

~~a laser for emitting the laser beam;~~

~~the mirror positioned to reflect the laser beam onto the sample; and~~

~~an injector gas conduit adapted to couple~~2. The method of claim 1, wherein the laser ablation mass cytometer further comprises: the laser ablation source with for generating ablated plumes from the ICP

~~produced by sample; an ICP torch, wherein said injector gas conduit passes through the opening~~

~~of the mirror, wherein the injector includes an injector inlet positioned within the laser~~

~~ablation source, for producing the ICP; and wherein a gas inlet coupled to the injector inlet is configured for capturing the set of~~

~~ablated plumes.~~

~~14.~~ The method of claim 13, whereinto pass a position of the sample is changed during gas from the gas inlet to the injector inlet for transferring the captured ablated plume into the ICP.

~~analysis; and wherein, during analysis, the laser beam remains stationary.~~

~~15.~~ The method of claim 13, wherein the laser beam pulses produce ablation spots

~~having diameters of at or less than 1 micron.~~

~~16.~~ 3. The method of claim 131, wherein the sample comprises cells laser beam passes through the aperture.

4. 17. The method of claim 1, wherein the laser beam is from a femtosecond laser.

5. The method of claim 1, wherein a position of the sample is changed during analysis; and wherein, during analysis, the laser beam remains stationary.

6. The method of claim 1, wherein the laser beam pulses produce 1 micron ablation spots or less.

7. The method of claim 1, wherein the injector further includes a sacrificial flow portion where part of a sheath flow surrounding plume material is discarded before the plume material is introduced into the ICP.

8. The method of claim 1, wherein a circumference of an outer surface of the sample cone decreases toward the aperture.

9. The method of claim 1, wherein the sample comprises cells.

10. ~~46~~ The method of claim 9, further comprising labeling the sample with at least one metal conjugated antibody.

11. A laser ablation system comprising: a laser configured to produce laser illumination; a laser ablation cell for holding a sample to be analyzed; and an injector for carrying an ablation plume to an ICP, the injector comprising a sample cone with a narrower portion of the sample cone forming an injector opening, and wherein the injector comprises an inlet for introducing a transfer gas flow into the injector, and an outlet for delivering an ablation plume to ICP-MS; and wherein the laser ablation cell comprises an inlet for introducing a capture gas flow, separate from the transfer gas flow, into the ablation cell.

12. The system of claim 11, further comprising a transfer gas source for producing a transfer flow in the injector and a capture gas source for producing a capture gas flow in the ablation cell.

13. The system of claim 11, wherein the laser is a femtosecond pulsed laser.

14. ~~18~~ The ~~method~~ system of claim ~~13~~ 11, wherein ~~each of the~~ laser is a solid state laser.

15. The system of claim 14, wherein the solid state laser is an Nd:YAG laser.

16. ~~set~~ The system of ~~ablated plumes is captured~~ claim 11, wherein the laser illumination is a laser beam pulse that produces an ablation spot of 1 um or less.

17. ~~distinctively~~ The system of claim 11, further comprising an inductively coupled plasma (ICP) torch coupled to the injector, and a mass analyzer configured to receive ions from the ICP torch.

18. ~~-~~ The system of claim 17, wherein the mass analyzer is a time of flight mass spectrometer.

19. The system of claim 11, wherein the injector further includes a sacrificial flow portion where part of a sheath flow surrounding plume material is discarded before the plume material is introduced into the ICP.

20. The system of claim 11, wherein the laser, the laser ablation cell, and the injector are configured so that the laser illumination originates on one side of the sample and the injector opening is on an opposite side of the sample.