system. Described herein are devices, systems, and methods for measuring particle sizes and/or size distributions within a microfluidic system, to overcome the pre-existing challenges and achieve the benefits as described herein. Such microfluidic systems may be used for the manufacture and formulation of biomolecule-containing products, such as therapeutics for individualized care.

[0004a] According to a first aspect of the invention, there is disclosed an apparatus comprising: a process chip, the process chip including: a fluid chamber, the fluid chamber including a fluid chamber inlet and a fluid chamber outlet, and an optically transmissive material adjacent to the fluid chamber; a dynamic light scattering assembly, the process chip to be removably positioned in relation to the dynamic light scattering assembly, the dynamic light scattering assembly to direct the light through the optically transmissive material and into the fluid chamber, the dynamic light scattering assembly further to receive light scattered by particles in fluid in the fluid chamber in response to the first optical fiber emitting light into the fluid chamber and thereby capture light scattering data; and a processor to determine viscosity of fluid in the fluid chamber based on the captured light scattering data, the processor further to determine one or both of size or size distribution of particles in the fluid based on the captured light scattering data, the process chip further including a plurality of mixing assemblies, each mixing assembly of the plurality of mixing assemblies having a plurality of inlets and an outlet, each mixing assembly of the plurality of mixing assemblies being configured to form a mixture of fluids from the plurality of inlets and communicate the mixture through the outlet, the process chip further comprising a fluid input port and a fluid input manifold channel, the plurality of inlets of the plurality of mixing assemblies being fluidically coupled with the fluid input manifold channel.

[0004b] According to another aspect of the invention, there is disclosed a method comprising: communicating a fluid mixture through a process chip, the fluid mixture including particles; emitting light toward the fluid mixture via a first optical fiber, the particles in the fluid mixture scattering the emitted light; receiving the light scattered from the particles in the fluid mixture, the received light being received by a second optical fiber obliquely oriented relative to the first optical fiber, the first and second optical fibers being secured to a body positioned near the process chip; performing autocorrelation on the received light; determining viscosity of the fluid mixture using at least the autocorrelation; and determining either a size of the particles in the fluid mixture using at least the autocorrelation, a size distribution of the particles in the fluid mixture using at least the autocorrelation, or a size and size distribution of the particles in the fluid mixture using at least the autocorrelation; communicating fluid through the process chip including: communicating a first fluid component from a fluid input manifold channel to a first

WHAT IS CLAIMED IS:

1. An apparatus comprising:

a process chip, the process chip including:

a fluid chamber, the fluid chamber including a fluid chamber inlet and a fluid chamber outlet, and

an optically transmissive material adjacent to the fluid chamber;

a dynamic light scattering assembly, the process chip to be removably positioned in relation to the dynamic light scattering assembly, the dynamic light scattering assembly to direct the light through the optically transmissive material and into the fluid chamber, the dynamic light scattering assembly further to receive light scattered by particles in fluid in the fluid chamber in response to the first optical fiber emitting light into the fluid chamber and thereby capture light scattering data; and

a processor to determine viscosity of fluid in the fluid chamber based on the captured light scattering data, the processor further to determine one or both of size or size distribution of particles in the fluid based on the captured light scattering data,

the process chip further including a plurality of mixing assemblies, each mixing assembly of the plurality of mixing assemblies having a plurality of inlets and an outlet, each mixing assembly of the plurality of mixing assemblies being configured to form a mixture of fluids from the plurality of inlets and communicate the mixture through the outlet,

the process chip further comprising a fluid input port and a fluid input manifold channel, the plurality of inlets of the plurality of mixing assemblies being fluidically coupled with the fluid input manifold channel.

2. The apparatus of claim 1, the process chip further including:

a first channel, the fluid chamber inlet being configured to receive a first fluid from the first channel, and

a second channel, the fluid chamber inlet being further configured to receive a second fluid from the second channel.

3. The apparatus of claim 2, the first fluid comprising a therapeutic composition.

4. The apparatus of claim 3, the therapeutic composition including at least some of the particles.

5. The apparatus of claim 4, the particles of the therapeutic composition comprising mRNA.

6. The apparatus of any of claims 2 through 5, the second fluid including at least some of the particles.

7. The apparatus of claim 6, the particles of the second fluid including beads.

8. The apparatus of claim 7, the first fluid comprising a therapeutic composition, the therapeutic composition including particles.

9. The apparatus of claim 8, the particles of the therapeutic composition having a first diameter, the beads having a second diameter different from the first diameter.

10. The apparatus of claim 9, the second diameter being larger than the first diameter.

11. A method comprising:

communicating a fluid mixture through a process chip, the fluid mixture including particles;

emitting light toward the fluid mixture via a first optical fiber, the particles in the fluid mixture scattering the emitted light;

receiving the light scattered from the particles in the fluid mixture, the received light being received by a second optical fiber obliquely oriented relative to the first optical fiber, the first and second optical fibers being secured to a body positioned near the process chip;

performing autocorrelation on the received light;

determining viscosity of the fluid mixture using at least the autocorrelation; and

determining either a size of the particles in the fluid mixture using at least the autocorrelation, a size distribution of the particles in the fluid mixture using at least the autocorrelation, or a size and size distribution of the particles in the fluid mixture using at least the autocorrelation;

communicating fluid through the process chip including:

communicating a first fluid component from a fluid input manifold channel to a first mixing assembly, the fluid input manifold channel being fluidically coupled to a second mixing assembly, the first fluid component including at least some of the particles,

communicating a second fluid component to the first mixing assembly, and

mixing the first and second fluid components together to form the fluid mixture.

12. The method of claim 11, the particles of the first fluid component including therapeutic particles.

13. The method of claim 12, the therapeutic particles including mRNA.

14. The method of claim 13, the mRNA being encapsulated in a delivery vehicle.

15. The method of any of claims 11 through 14, the second fluid component including at least some of the particles.

16. The method of claim 15, the particles of the second fluid component including beads.