are affixed to the housing plate and the circuitry applies current to each of the ~~pzeizo~~piezo- ceramic disks to generate ultrasonic waves that are emitted through the housing plate towards the flow reactor. In accordance with some of these embodiments, the ultrasonic waves are emitted in the absence of carrying medium. In accordance with some of these embodiments, the ultrasonic waves are emitted by having the piezo- ceramic disk in direct contact with a horn; and the entire piezo-ceramic disk and horn system being affixed to the housing plate.

In accordance with some embodiments of this invention, the transducer is positioned on a first side of the flow reactor and a second apparatus for applying a second type of energy to the flow reactor is on a second side of the flow reactor. In accordance with some of these embodiments of the invention, the second type of energy is selected from a group of energies consisting of microwave energy, thermal energy, and ultraviolet radiation.

In accordance with embodiments of this invention, the method of generating a product from a continuous flow product is performed in the following manner. Reagents flow into a flow reactor. Ultrasonic energy and a second energy are simultaneously applied to the reagents in the flow reactor. The generated product then flows out of the flow reactor. In accordance with some of these embodiments, the second energy is thermal energy. In accordance with some of these embodiments, the second energy is microwave energy. In accordance with some of these embodiments, the second energy is ultraviolet light.

In accordance with some embodiments of the method of this invention, the simultaneous application of the ultrasonic energy and the second energy is performed by transmitting ultrasonic waves from a first side of the flow reactor; and transmitting the second energy from a second side of the flow reactor. In accordance with some of these embodiments, the ultrasonic waves are transmitted from an ultrasonic transducer that is in direct contact with the flow reactor. In accordance with some of these embodiments, the step of simultaneously applying the ultrasonic energy and the second energy is performed in the absence of a carrying medium.

Brief Description of the Drawings

The above and other features and advantages of systems and methods in accordance with this invention are described in the following detailed description and are shown in the following drawings:

What is claimed is:

1. An apparatus for applying ultrasonic energy to a flow reactor comprising:

a housing plate;

a piezo-ceramic disk affixed to said housing plate;

a coupling for securing said housing plate in a position wherein said housing plate is in direct contact with a flow reactor; and

circuitry for applying current to said piezo-ceramic disk to cause said piezo-ceramic disk to generate ultrasonic waves that are emitted through the said housing plate towards said flow reactor; and

wherein said ultrasonic waves are emitted in the absence of a carrying medium.

2. The apparatus for applying ultrasonic energy to said flow reactor of claim 1 further comprising:

a plurality of piezo-ceramic disks including said piezo-ceramic affixed to said housing plate wherein said circuitry for applying said current applies said current to each of said plurality of ~~pzeizo~~piezo-ceramic disks to generate ultrasonic waves that are emitted through the said housing plate towards said flow reactor.

3. The apparatus of claim 1 further comprising:

a horn having a first end affixed to said piezo-ceramic disk and a second end affixed to said housing plate to affix said piezo-ceramic disk to said housing plate.

~~4. The apparatus of claim 1 wherein said ultrasonic waves are emitted in the absence of carrying medium.~~

~~5~~4. The apparatus of claim 1 wherein said apparatus is on a first side of said flow reactor and a second apparatus for applying a second type of energy to said flow reactor is on a second side of said flow reactor.

~~6~~5. The apparatus of claim ~~5~~4 wherein said second type of energy is selected from a group of energies consisting of microwave energy, thermal energy, and ultraviolet radiation.

~~7~~6. A method for generating a product using a continuous flow process comprising:

flowing a plurality of reagents into a flow reactor;

simultaneously applying a ultrasonic energy and a second energy to said plurality of reagents in said flow reactor; and

flowing a product generated from said reagents out of said flow reactor; and wherein said ultrasonic energy is applied in the absence of a carrying medium.

~~8~~7. The method of claim ~~7~~ 6 wherein said second energy is thermal energy.

~~9~~8. The method of claim ~~7~~ 6 wherein said second energy is microwave energy.

~~10~~9. The method of claim ~~7~~ 6 wherein said second energy is ultraviolet light.

~~11~~10. The method of claim ~~7~~ 6 wherein said step of simultaneously applying said ultrasonic energy and said second energy comprises:

transmitting ultrasonic waves from a first side of said flow reactor; and

transmitting said second energy from a second side of said flow reactor.

~~12~~11. The method of claim ~~7~~ 6 wherein said step of simultaneously applying said ultrasonic energy and said second energy comprises:

transmitting ultrasonic waves from a ultrasonic transducer that is in direct contact with said flow reactor.

~~13. The method of claim 7 wherein said ultrasonic energy is applied in the absence of a carrying medium.~~