

5 CLAIMS

1. A cell lysis system comprising:
a driver apparatus which incorporates:
a plurality of driver output terminals which provide an electrical
10 connection between the driver apparatus and a cell lysis device to drive
an ultrasonic transducer within the cell lysis device;
an AC driver which generates an AC drive signal at a
predetermined frequency and outputs the AC drive signal at the driver
output terminals to drive the ultrasonic transducer within the cell lysis
15 device;
an active power monitoring arrangement which monitors the
active power used by the ultrasonic transducer when the ultrasonic
transducer is driven by the AC drive signal, wherein the active power
monitoring arrangement provides a monitoring signal which is indicative
20 of an active power used by the ultrasonic transducer;
a processor which controls the AC driver and receives the
monitoring signal from the active power monitoring arrangement; and
a memory storing instructions which, when executed by the
processor, cause the processor to:
25 A. control the AC driver to output an AC drive signal to the
ultrasonic transducer at a predetermined sweep frequency;
B. calculate the active power being used by the ultrasonic
transducer based on the monitoring signal;
C. control the AC driver to modulate the AC drive signal to
30 maximise the active power being used by the ultrasonic
transducer;
D. store a record in the memory of the maximum active
power used by the ultrasonic transducer and the sweep frequency
of the AC drive signal;
35 E. repeat steps A-D for a predetermined number of
iterations with the sweep frequency incrementing with each

- 5 iteration such that, after the predetermined number of iterations has occurred, the sweep frequency has been incremented from a start sweep frequency to an end sweep frequency;
- F. identify from the records stored in the memory the optimum frequency for the AC drive signal which is the sweep
10 frequency of the AC drive signal at which a maximum active power is used by the ultrasonic transducer; and
- G. control the AC driver to output an AC drive signal to the ultrasonic transducer at the optimum frequency.
- 15 2. The system of claim 1, wherein the active power monitoring arrangement comprises:
a current sensing arrangement which senses a drive current of the AC drive signal driving the ultrasonic transducer, wherein the active power monitoring arrangement provides a monitoring signal which is indicative of the
20 sensed drive current.
3. The system of claim 1 or claim 2, wherein the memory stores instructions which, when executed by the processor, cause the processor to:
repeat steps A-D with the sweep frequency being incremented from a
25 start sweep frequency of 2800kHz to an end sweep frequency of 3200kHz.
4. The system of any one of the preceding claims, wherein the memory stores instructions which, when executed by the processor, cause the processor to:
30 in step G, control the AC driver to output an AC drive signal to the ultrasonic transducer at frequency which is shifted by between 1-10% of the optimum frequency.
5. The system of any one of the preceding claims, wherein the AC driver
35 modulates the AC drive signal by pulse width modulation to maximise the active power being used by the ultrasonic transducer.

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6. The system of any one of the preceding claims, wherein the memory stores instructions which, when executed by the processor, cause the processor to:

control the AC driver to alternately output an AC drive signal to the ultrasonic transducer at the optimum frequency for a first predetermined length of time and to not output an AC drive signal to the ultrasonic transducer for a second predetermined length of time.

7. The system of claim 6, wherein the memory stores instructions which, when executed by the processor, cause the processor to:

alternately output the AC drive signal and to not output the AC drive signal according to an operating mode selected from:

Operating mode	First predetermined length of time (seconds)	Second predetermined length of time (seconds)
1	4	2
2	3	2
3	2	2
4	1	2
5	1	1
6	2	1
7	3	1
8	4	1
9	4	3
10	3	3
11	2	3
12	1	3

8. The system of any one of the preceding claims, wherein the system further comprises:

a cell lysis device which is releasably attached to the driver apparatus, the cell lysis device comprising:

a housing;

5 a plurality of electrical terminals which are connected electrically
to the plurality of driver output terminals;
 a sonication chamber provided within the housing, the sonication
chamber being at least partly filled with an ultrasonic wave transfer
medium, wherein the housing comprises an opening which is configured
10 to receive a sample container such that a part of the sample container
projects into the ultrasonic wave transfer medium;
 an ultrasonic transducer which generates ultrasonic waves in the
ultrasonic wave transfer medium within the sonication chamber, wherein
the ultrasonic waves are transferred by the ultrasonic wave transfer
15 medium from the ultrasonic transducer to the sample container to lyse
cells when cells are contained within the sample container.

9. The system of claim 8, wherein the driver apparatus comprises a first
interference fit attachment and the cell lysis device comprises a second
20 interference fit attachment, and wherein the first interference fit attachment
releasably attaches to the second interference fit attachment to releasably
attach the cell lysis device to the driver apparatus.

10. A cell lysis device comprising:
25 a housing;
 a sonication chamber provided within the housing, the sonication
chamber being at least partly filled with an ultrasonic wave transfer medium,
wherein the housing comprises an opening which is configured to receive a
sample container such that a part of the sample container projects into the
30 ultrasonic wave transfer medium;
 an ultrasonic transducer which generates ultrasonic waves in the
ultrasonic wave transfer medium within the sonication chamber, wherein the
ultrasonic waves are transferred by the ultrasonic wave transfer medium from
the ultrasonic transducer to the sample container to lyse cells when cells are
35 contained within the sample container.

- 5 11. The device of claim 10, wherein the ultrasonic transducer is at least partly of a compound comprising lead, zirconium and titanium.
12. The device of claim 10 or claim 11, wherein the ultrasonic transducer is a circular disc shape and has a diameter of 16mm and a thickness of 0.7mm.
- 10 13. The device of any one of claims 10 to 12, wherein the ultrasonic transducer comprises a first electrode and a second electrode which are provided on opposing sides of the ultrasonic transducer, wherein the first electrode and the second electrode comprise silver and the capacitance
- 15 between the first electrode and the second electrode is 800pF to 1300pF.
14. The device of claim 13, wherein the first electrode is at least partly covered with a glass coating.
- 20 15. The device of any one of claims 10 to 14, wherein the ultrasonic transducer is carried by a transducer holder which is of silicone rubber.
16. The device of any one of claims 10 to 15, wherein the ultrasonic wave transfer medium comprises vegetable glycerine.
- 25 17. The device of any one of claims 10 to 16, wherein the sample container is a microcentrifuge tube.
18. A method of lysing cells in a sample, the method comprising:
- 30 placing a liquid sample containing cells to be lysed in a sample container;
- positioning the sample container through an opening in a housing of a cell lysis device such that a part of the sample container projects into an ultrasonic wave transfer medium provided in a sonication chamber within the
- 35 housing; and

5 attaching the cell lysis device to a driver apparatus, the driver apparatus incorporating:

 an AC driver which generates an AC drive signal at a predetermined frequency and outputs the AC drive signal at the driver output terminals to drive an ultrasonic transducer within the cell lysis device;

10 an active power monitoring arrangement which monitors the active power used by the ultrasonic transducer when the ultrasonic transducer is driven by the AC drive signal, wherein the active power monitoring arrangement provides a monitoring signal which is indicative of an active power used by the ultrasonic transducer,

15 wherein the method further comprises:

 A. controlling, by a processor, the AC driver to output an AC drive signal to the ultrasonic transducer at a predetermined sweep frequency;

 B. calculating, by the processor, the active power being used by the ultrasonic transducer based on the monitoring signal;

20 C. controlling, by the processor, the AC driver to modulate the AC drive signal to maximise the active power being used by the ultrasonic transducer;

 D. storing a record in a memory of the maximum active power used by the ultrasonic transducer and the sweep frequency of the AC drive signal;

 E. repeating steps A-D for a predetermined number of iterations with the sweep frequency incrementing with each iteration such that, after the predetermined number of iterations has occurred, the sweep frequency has been incremented from a start sweep frequency to an end sweep frequency;

30 F. identifying, by the processor, from the records stored in the memory the optimum frequency for the AC drive signal which is the sweep frequency of the AC drive signal at which a maximum active power is used by the ultrasonic transducer; and

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5 G. controlling, by the processor, the AC driver to output an AC
drive signal to the ultrasonic transducer at the optimum frequency.

19. The method of claim 18, wherein the method further comprises:
repeating steps A-D with the sweep frequency being incremented from a
10 start sweep frequency of 2800kHz to an end sweep frequency of 3200kHz.

20. The method of claim 18 or claim 19, wherein the method further
comprises:
controlling, by the processor, the AC driver to alternately output an AC
15 drive signal to the ultrasonic transducer at the optimum frequency for a first
predetermined length of time and to not output an AC drive signal to the
ultrasonic transducer for a second predetermined length of time.

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