those that can do so in a manner that reduces the likelihood of contamination and/or arcing caused by bubble formation within the processed cell-containing fluid.

BRIEF SUMMARY

[0011] Implementations of the present disclosure solve one or more of the foregoing or other problems in the art with systems, devices, and methods for electroporating a cell-containing fluid. The terms "cell-containing fluid" and "sample" are used interchangeably herein.

[0012] In particular, one exemplary embodiment includes an electroporation cartridge having an electroporation chamber defined by an elongate body, a first electrode disposed at a proximal end of the electroporation chamber, and a second electrode disposed at an opposite, distal end of the electroporation chamber. At least one of the first electrode or the second electrode is moveable between a capped position for electroporation and an uncapped position for loading a sample for a single use or automated batch processing and/or the electroporation cartridge is configurable between sealed and unsealed states. The electroporation cartridge further includes a fluid overfill space associated with a proximal region of the electroporation chamber and configured to receive a volume of overfill displaced upon sealing the electroporation chamber. A distal end of the first electrode comprises a distal surface and an annular tapered portion surrounding the distal surface.

[0013] In one aspect, an elongate body of the disclosure can comprise, be made of or include one or more of a non-conductive plastic, a glass, and/or a ceramic and is configured to receive a cell-containing liquid to be electroporated within the electroporation chamber defined by the elongate body. For example, an electroporation chamber of the disclosure can comprise, be made of or includes a glass and/or a ceramic. As an additional example, the electroporation chamber can comprise, be made of or include polycarbonate and/or other non-conductive irradiation-stable plastic.

[0014] In one aspect, at least a portion of an electroporation chamber of the disclosure is tapered between the first electrode and the second electrode. When present, the tapered portion of the electroporation chamber does not substantially interfere with generation of a uniform electric field between the first and second electrodes.

[0015] Additionally or alternatively, an electroporation chamber of the disclosure has a uniform cross section along a length of the reaction chamber. The uniform cross section can, in some instances, extend an entire length of the electroporation chamber between the first and second electrodes such that the electroporation cartridge is configured to produce a uniform electric field within the electroporation chamber. For example, an electroporation chamber of the disclosure can be a cylindrical cavity defined by the elongate body such that the uniform cross section is a circle.

CLAIMS

1. An electroporation cartridge, comprising:

an electroporation chamber defined by an elongate body;

a first electrode disposed at a proximal end of the electroporation chamber;

a second electrode disposed at an opposite, distal end of the electroporation chamber, wherein at least one of the first electrode or second electrode is moveable between a capped position for electroporation and an uncapped position for loading a sample and/or the electroporation cartridge is configurable between sealed and unsealed states; and

a fluid overfill space associated with a proximal region of the electroporation chamber and configured to receive a volume of overfill displaced upon sealing the electroporation chamber,

wherein a distal end of the first electrode comprises a distal surface and an annular tapered portion surrounding the distal surface.

2. The electroporation cartridge of claim 1, wherein at least a portion of the electroporation chamber is tapered between the first electrode and the second electrode.

3. The electroporation cartridge of claim 1 or claim 2, wherein the electroporation chamber comprises a uniform cross section along a length of the reaction chamber.

4. The electroporation cartridge of any one of claims 1–3, further comprising a proximal sidewall defined between a proximal opening of the elongate body and an inflection point of the sidewall defining the electroporation chamber, wherein the proximal sidewall narrows from a first diameter defined by the proximal opening to a second, smaller diameter defined at a position distal to the inflection point.

5. The electroporation cartridge of any one of claims 1–4, wherein the first electrode comprises a bulbous extension having the distal surface, and wherein the distal surface has a flat, convex or angled contour.

6. The electroporation cartridge of any one of claims 1–5, wherein the first electrode is operable to configure the electroporation cartridge between sealed and unsealed states without an additional removable cap piece, or wherein the first electrode is a removable cap.

7. The electroporation cartridge of any one of claims 1-6, wherein a proximal surface of the second electrode comprises a flat, uniform surface and/or is orthogonal to a longitudinal axis of the electroporation chamber.

8. The electroporation cartridge of any one of claims 1-7, further comprising a volume reducing sleeve configured in size and shape to fit within the electroporation chamber.

9. The electroporation cartridge of any one of claims 1-8, further comprising one or more stabilizers.

10. The electroporation cartridge of claim 9, wherein the one or more stabilizers comprise feet positioned at the same elevation as a base of the cartridge.

11. The electroporation cartridge of any one of claims 1-10, wherein the first electrode comprises an electrode cap, the electrode cap configured to securely retain an authentication chip within a recess.

12. The electroporation cartridge of claim 11, wherein the electrode cap comprises a plurality of pin ports for communication between an electroporation system and the authentication chip.