Analytical Instrumentation, Methods & Materials

Microfluidic Systems and Methods Applicable to *In Vitro* Fertilization

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a microfluidic device and system that are useful in improving *in vitro* fertilization techniques.

Overview

Microfluidic systems and methods can provide many functions of larger systems and facilities, such as entire laboratories, with increased efficiency as well as reduced size, cost and complexity. Such microfluidic systems and methods have applications in many fields, including biology.

For example, technology-assisted reproduction techniques in which embryos are handled independently from their biological source are growing in importance and frequency of use. Agricultural industries rely on assisted reproduction techniques such as embryo manipulation and embryo transfer to increase genetic evolution of cattle and permit exceptional genetic characteristics to be passed on to greater numbers of offspring, but these techniques are expensive and have relatively low success rates. Failure rates are primarily attributable to the significant handling and manipulation of embryos in executing these techniques. Microfluidic devices and systems that improve assisted reproduction techniques are needed.

The Invention

UW-Madison researchers have developed a microfluidic device and method that are applicable to *in vitro* fertilization techniques. The device comprises a substrate with a plurality of microchannels placed in the substrate so that each microchannel includes an inlet at one end to receive a cell and an outlet at the opposite end. Each microchannel also includes a restriction near the outlet to allow the cell to be contained as fluid passes through the channel. At least two microchannels make up an inlet on the substrate, which aligns with a fluid-handling device. The device may be constructed using microfabrication techniques such as injection molding, and may include an automatic top-off system using surface tension-based valve. This inexpensive top-off system reduces inaccurate liquid handling in the microfluidic system, which can lead to contamination of the sample.

The invention provides a flexible platform that allows microscale wells to be sized to accommodate a certain species' cell size, as well as a fabricated insert to allow the specially sized wells to be included in the system. The system may be configured as a ready-to-use culture system tailored for particular applications, allowing improved embryo growth through optimized cell-to-cell communication. An open-closed-open-closed-open (OCOCO) system may be used for efficient cell culture and convenient sample access, which improves yield by eliminating damage to the sample due to over-handling.

Applications

- Automated, high-throughput *in vitro* fertilization
- Chemotaxis study with high throughput sperm migration
- Oocyte/embryo culture with microfluidic well inserts
- Dairy cattle production

- Other fields requiring microfluidic systems and methods

Key Benefits

- Reduces excessive handling and manipulation of cells to improve success rates of assisted reproduction techniques
- Requires less sperm than conventional *in vitro* fertilization techniques
- Accommodates a wide variety of animal species
- May include an OCOCO system for efficient cell culture and convenient sample access
- Provides precise and accurate control of the microenvironment surrounding cells

Additional Information

For More Information About the Inventors

- David Beebe

Publications

- Beebe D., Wheeler M., Zeringue H., Walters E. and Raty S. 2002. Microfluidic Technology for Assisted Reproduction. Theriogenology. 57, 125-135.
- Glasgow I.K., Zeringue H.C., Beebe D.J., Seong-Jun C., Lyman J.T, Chan N.G. and Wheeler M.B. 2001. Handling Individual Mammalian Embryos Using Microfluidics. IEEE T. Bio-Med. Eng. 48, 570-758.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Microfluidics

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846