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High throughput cryopreservation system for up to millimeter-sized samples

A method for cryopreservation of large (100-1000micron dia.) biological samples while improving cell viability.

IP Status:

US Patent Issued, 11,311,008, Cryopreservation compositions and methods involving nanowarming

US Patent Pending, 17/262,126, Systems and Methods for Cryopreservation of Biomaterials

PCT Filed, PCT/US2020/19692, High Throughput System for Production And Vitrification Of Biomaterials In Cryoprotectant Droplets

Applications

- Cryopreservation - germplasm banking, regenerative medicine, reproduction technologies

Key Benefits & Differentiators

- Cryopreservation of large biosamples (100-1000 micron dia.)
- High throughput cooling, sorting and thawing
- 4x lower CPA concentration, thereby reducing cryoprotectant toxicity
- Higher viability

Overview

Cryopreservation of immortalized cell lines and other biological samples is routine in many biomedical labs using conventional cryopreservation approaches such as controlled rate freezing (1 K/min). These biological samples are often smaller than 100 micron in diameter. However, for larger biological samples (>100 micron dia.) existing cryopreservation techniques are ineffective; slow cooling and warming rates due to large sample volumes result in cell injury and death. Therefore, new techniques to effectively preserve large biological samples such as embryos, cell aggregates, germplasm, tissues, etc. are needed.

Researchers at the University of Minnesota have developed a novel high throughput cryopreservation system for biological samples in the 100 - 2000 micron size range. Using a combination of new printing, sorting, and warming techniques, the researchers have successfully demonstrated vitrification and crystallization-free thawing of droplets with 1000x higher volume than that is demonstrated with currently available techniques. The system includes a "pick & print" method, which solves the tip blocking issue associated with conventional printing methods, for rapid placement of samples into cryopreservation chambers. Ultrafast cooling to vitrify samples is achieved by dropping the samples onto a cryogenic copper dish. This in turn, allows usage of toxic cryoprotective agents (CPA) at lower concentrations (<3 M). Next, a new nanoparticle-assisted laser warming method is used to

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rapidly rewarm these millimeter-sized biosamples and overcome ice formation and resulting injury. Finally, a microfluidic sorting platform was developed to handle and sort large quantities of biomaterials at different stages of cryopreservation procedures, thereby improving the efficiency.

Applications may include cryopreserved storage, banking and reconstitution of cells and aggregates (e.g. pancreatic islets), embryos or oocytes (e.g.. vertebrate biomedical models) from important farmed or endangered species.

Phase of Development

TRL: 3
Proof of concept.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

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