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C2Or2C-07: Observation and analysis of the ultra-rapid cooling effect of cryoprotectant droplets on a sapphire surface

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Cryopreservation has emerged as a promising technology to provide the semipermanent storage of biomaterials widely used in assisted reproduction and cell therapy. A large portion of successful cryopreservation requires the combination of ultra-rapid cooling and appropriate low-toxicity cryoprotectant agents, which inhibits the formation of ice crystals that damages the cells lethally. Conventional approaches are not competent in realizing high enough cooling rate and large enough volume of the samples, and more importantly, not able to track the instant appearance of the sample at a microscale level during the momentary cooling process. A rapid freezing device for the droplet sample study purpose was designed and developed, which is capable of microscopic visualization of sample on a sapphire surface at a vitrification cooling rate up to 10^4 K/min. Cooling and freezing tests of several frequently used cryopreservation samples have been conducted on the device. The relationship between the crystallinity, the temperature uniformity and the cooling rate was interpreted, which provides new insights to a better understanding of the cryopreservation technology and guidance for new cryogenic bioinstrumentation development.

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