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CoFe nanowires for remote heating using an alternating magnetic field

A nanowire material for remote, rapid and uniform heating of biological samples.

IP Status: Pending US Patent; **Application #:** 16/852,850

Applications

- Cryopreservation
- Hyperthermia treatment of cancers
- Remote heating
- Medical imaging

Key Benefits & Differentiators

- **Rapid and uniform heating** even in non-uniform magnetic field
- **Alignment on-demand for faster heating** due to magnetic anisotropy of nanowires
- **Suitable for biological uses** because of its low cellular toxicity
- Cryopreservation material can be **perfused or suspended**
- **Tunable heating rate** based on alignment, nanowire dimensions and applied field strength

Magnetic nanowires for rapid heating

Researchers at the University of Minnesota have developed a CoFe-based magnetic nanowire material that generates heat when placed in an alternating magnetic field. High saturation magnetization and magnetic anisotropy of this material makes it ideal for applications that require remote, rapid and uniform heating. Additionally, on-demand alignment of these nanowires offers higher heating rates (up to 1000°C/min). Furthermore, these nanowires can be coated with chemical agents to improve shelf life, buoyancy, dispersibility and biocompatibility. Low cellular toxicity makes this material suitable for applications in thawing of cryopreserved tissues and organs, medical hyperthermia treatments for ablation of diseased tissues, and medical imaging.

Thawing without devitrification

Vitrification, or ice-free cryopreservation, of tissues and organs is performed by the cooling of biomaterials in the presence of cryoprotective agents. Successful rewarming of these cryogenically stored samples requires 1) rapid heating rates to avoid crystallization (devitrification), and 2) uniform heating of the entire volume to avoid fracture or damage. Currently, there are no biocompatible, cryoprotective materials that can facilitate rapid and uniform heating of volumes larger than droplets or thin films. The CoFe magnetic nanowires fabricated by Prof. Stadler and Prof. Bischof, when mixed with a common cryoprotective agent (VS55), shows promising results. Vitrified glycerol and VS55 solutions containing nanowire-cryoprotective agent combination can be heated at rates up to 1000°C/min. With rapid, uniform heating, and minimal cell toxicity, this nanowire material presents an excellent potential for nanowarming cryopreserved biomaterials.

Phase of Development

Technology ID

2019-122

Category

Engineering & Physical Sciences/Chemicals
Engineering & Physical Sciences/Materials
Life Sciences/Biomarkers
Life Sciences/Diagnostics & Imaging
Life Sciences/Industrial Biotech
Life Sciences/Medical Devices
Life Sciences/Research Tools
Life Sciences/Therapeutics
Agriculture & Veterinary/Ag Biotechnology
Agriculture & Veterinary/Veterinary Medicine
Cryopreservation

Learn more

Proof of Concept. The researchers have fabricated nanowires in 1-2 gram batches. The material has been evaluated for heating rates in cryoprotectants and tested for cytotoxicity in vitro in the presence of alternating magnetic fields.

Researchers

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Publications

Nanowarming using Au-tipped Co 35 Fe 65 ferromagnetic nanowires.
Nanoscale 11.31 (2019): 14607-14615.,

Ready for Licensing

This technology is now available for license! The University is excited to partner with industry to see this innovation reach its potential. Please contact us to share your business' needs and your licensing interests in this technology. The license is for the sale, manufacture or use of products claimed by the patents.