Preparation of Uniform Nanodrugs Using Modified Ice-Template

Health & Wellness
Manufacturing
Biomedical and Genetic Engineering
Nanotechnology and New Materials

Opportunity
Due to their very small particle size, nanodrugs offer many advantages, such as good bioavailability and water dispersibility and passive tumour targeting abilities superior to those of other drugs. These characteristics have enabled new drug delivery modes and revealed previously unknown drug properties. Conventional nanodrug production methods are based on the re-precipitation of a drug compound dissolved in an organic solvent, which forms tiny particles when dropped into water. However, this method has been hindered by low production rates and high inter-batch variability. Precipitation within an ice template has been proposed to improve the nanodrug production process; tiny pores within the ice restrict the size of nanodrug particles, which can be collected by melting the template. However, this method has not yielded adequately uniform drug particles due to the precipitation of some of the drug on the ice surface, rather than in pores. An improved ice template method for uniform nanodrug production is needed.

Technology
This invention proposes a new method for producing an ice template and subsequently producing nanodrug particles. The template is produced using readily available laboratory equipment. Water is added to a well (or wells) of a 24-well microplate and flash-frozen using a freezer at -20°C and an optional liquid nitrogen bath. The nanodrug in organic solvent is dropped on top of the ice, and particle formation on the surface can be reduced by subsequently applying pure solvent to push the drug further into the ice pores. After perfusion at a very low temperature, the solvent is evaporated by air or inert gas flow over the template. Finally, the template is thawed and the nanodrug particles collected. The well walls both define the ice template surface area and restrict the nanodrug solution flow, respectively allowing calculation of the optimal volume of drug solution per template and reducing the need to apply the drug solution evenly over the template surface.

Advantages
- Simple and cost-effective: uses standard laboratory equipment
- Increased particle size uniformity
- Microplate wells retain added drug–organic solution within the well
• Known ice surface area facilitates volume calculations

Applications

• Drug discovery
• Pharmacology research
• Organic chemistry research
• Chemical biology research
• Pharmaceuticals