**[Ice recrystallization inhibiting polymer nanoparticles via polymerization-induced self-assembly (PISA)](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201" \l "sessionCollapse394051)**

[*Panagiotis Georgiou*](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201)*,* [*Thomas Congdon*](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201)*,*[*Thomas Whale*](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201)*, [Ioanna Kontopoulou](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201),*[*Alexander Baker*](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201)*, [Huba Marton](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201), and*[*Matthew Ian Gibson*](https://acs.digitellinc.com/acs/live/22/page/677/5?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201)

*University of Warwick*

Ice growth is a major problem in cell storage, infrastructure maintenance and in food industry. Chemical tools to modulate ice formation/growth have great (bio)technological value. Existing solutions to control ice growth have focussed on using antifreeze/ice-binding proteins from extremophile organisms, while recently polymeric inhibitors have emerged. Previous reports of nanomaterial architectures containing ice recrystallisation-active macromolecules did not show enhancements in activity. In contrast, native antifreeze proteins show size and aggregation state-dependent activity.
In this work, the concept of using polymerization-induced self-assembly (PISA) to generate unique nanomaterials that are capable of inhibiting ice growth is shown for the first time. We introduce polymer nanomaterials that are potent inhibitors of ice recrystallization, employing steric stabilizing polymers known to inhibit ice growth such as poly(vinyl alcohol) (PVA) and others, with not any known activity such as poly(ethylene glycol) (PEG), and poly(vinyl pyrrolidone) (PVP). Crucially, engineering the core-forming block with poly(diacetone acrylamide) enabled PISA to be conducted in saline media. In the first case, a PVA graft macroinitiator was developed to perform PISA and the most active particles inhibited ice growth as low as 0.5 mg.mL-1 and were more active than the PVA stabilizing block alone, showing that the dense packing of this nanoparticle format enhanced activity. PEG and PVP coronas were also active when assembled into nanoparticle formulations, whereas the core-block composition had no impact. This challenges the hypothesis that specific ice-binding domains are essential for activity. Larger nanoparticles demonstrated higher activity than smaller ones, but ice-nucleation activity was not observed in this case. This approach offers a platform towards ice-controlling soft materials using a broad range of polymers that are synthetically accessible and tuneable.

