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Role of synthetic antifreeze agents in catalyzing ice nucleation

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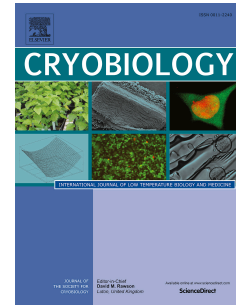
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1 **Role of Synthetic Antifreeze Agents in Catalyzing Ice Nucleation**

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10 11 **Abstract**

12 Nature endows antifreeze (glyco)proteins (AF(G)Ps) with the excellent capability of inhibiting
13 ice crystal growth. Recent years have also witnessed the emergence of many potent AF(G)P
14 mimics such as poly(vinyl alcohol) (PVA). As researchers are revealing the molecular
15 mechanisms of inhibiting ice crystal growth by AF(G)Ps and their synthetic substitutes, there
16 remains no agreement about their effect on ice nucleation. In this study, we report the
17 observation of ice nucleation catalyzed by PVA of different polymerization degrees using a
18 freeze-on-a-chip platform which allows the monitoring of freezing and melting events over
19 hundreds of monodisperse, picoliter-sized aqueous droplets. Aqueous droplets made of 1
20 mg/ml PVA solution exhibit a median freezing temperature of around -36 °C, two degrees
21 higher than the observed homogeneous nucleation temperature of water. The findings in our
22 study bring useful insights into the different roles of synthetic antifreeze agents in controlling
23 ice formation.

24
25 **Keywords:** Antifreeze protein; poly(vinyl alcohol); ice crystallization inhibition; median freezing
26 temperature; heterogeneous ice nucleation; microfluidics

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