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Investigation of Antifreeze Proteins on the Surface of Ice using Vibrational Sum-Frequency Generation Spectroscopy

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Antifreeze proteins (AFPs) and Antifreeze Glycoproteins (AFGPs) collectively abbreviated as AF(G)Ps are a unique class of proteins that modify ice crystal growth and thereby ensure the survival of organism in freezing and subfreezing habitats. The molecular working mechanism behind AF(G)Ps freezing inhibition is not well understood, because, as yet, there are no experimental techniques that allow obtaining molecular details on how antifreeze proteins function directly at the surface of ice. Here we use surface specific heterodyne-detected vibrational sum-frequency generation spectroscopy (HD-VSFG) to study the properties of antifreeze proteins directly at the ice surface and at the molecular level.

Significance statement

Antifreeze proteins (AFPs) enable the survival of various organisms in freezing or subfreezing habitats by preventing the macroscopic growth of ice crystals. Understanding how AFPs recognize and bind ice crystals is the most important step to unravel their working mechanism.

Author: Dr MEISTER, Konrad (AMOLF)

Co-authors: Prof. DEVRIES, Art (University of Illinois); Ms MOLL, Carolyn (AMOLF); Prof. RAMLOV, Hans (Roskilde University); Prof. BAKKER, Huib J. (AMOLF)

Presenter: Dr MEISTER, Konrad (AMOLF)

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