Ice Freezing Induced by Amphiphilic Alcohols and Local Electric Fields of Polar Crystals.

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Pure water can be super-cooled to temperatures of -20º to -40ºC. Therefore the induction or inhibition of freezing of ice in particular through the role of auxiliaries has far reaching ramifications for the living and non-living world. For instance cloud seeding by silver iodide crystals, anti freeze proteins in the blood serum, or wide scale damage to crops by frost bacteria. In the present lecture we shall describe induced freezing of ice by two different methods.

(i):-Spreading of aliphatic long chain alcohols induce ice nucleation approaching 0ºC, in contrast with water soluble alcohols which effective antifreeze agents. The freezing point induced by the amphiphilic alcohols was sensitive not only to surface area/per molecule but for the aliphatic series ($CnH_{2n+1}OH$) to chain length and parity. The higher freezing point induced by these alcohols is due to the formation of ordered clusters in the uncompressed state as demonstrated by Grazing Incidence X-ray Diffraction measurements. The diffraction data indicated a close lattice match with the layer of hexagonal ice.

(ii):- The application of local electric fields on drops of water help to align the water molecules into ice-like clusters en route to freezing. The hydrophobic faces of single crystals of a series of pairs of racemic and chiral- resolved hydrophobic α-amino acids were used as a substrate, onto which water vapor has been cooled to freezing. The morphologies and molecular packing arrangements within each exposed crystal pair surfaces are similar but only one of each pair exhibits a polar axis, parallel to the hydrophobic face exposed to water. Those crystals that have a polar axis, parallel to the hydrophobic face induce a freezing point higher by 4 to 5ºC than the corresponding crystals that do not have a polar axis. The results are interpreted in terms of an electric field mechanism present in the crevices of the surfaces of the host crystals where the hexagonal ice crystals start growing. This electric field helps to align the water molecules into-ice-like clusters en route to freezing.