High Temperature Ice Nucleation Induced by Pyroelectric Effect in Amino Acids Crystals

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***Abstract*— Pyroelectricity [1-2] is a phenomenon, which comprises the creation of external electric field in certain polar materials as a result of a change of temperature. This property is confined only to crystals belonging to the ten polar classes out of the 32 known. Such materials are commonly used as IR sensors. It has long been suggested that electric fields might possibly promote freezing of super cooled water [3]. Our group has demonstrated that polar crystals can catalyze the freezing of supercooled water [4], and that positive pyroelectric charge can align water molecules in ice-like configuration [5]. In order to confirm experimentally and quantitatively the role played by the pyroelectric effect, we correlated between the varying pyroelectric effect of a given crystal and the freezing point of supper cooled water on the surface of the same crystal. Using the "tailor-made" host guest method for symmetry reduction [6], we were able to manipulate the polarity of the mixed crystals of L-Asparagine monohydrate/L-Aspartic acid (ASN/ASP) and consequently its pyroelectric effect. In addition, other systems of amino acids (L-ASP, D/L-Alanine with similar pyroelectric properties were tested. Our studies show that relatively large pyroelectric effect induces ice nucleation close to 0°C. These results were observed not only on the surfaces perpendicular to the polar axis, but also on a surface parallel to it, which does not show any pyroelectric effect. A possible explanation for that phenomenon is that ice nucleation can be induced by generating a pyroelectric field in surface defects that are parallel to the polar axis of the crystals. We supported further our hypothesis, by demonstrating that a removal of the pyroelectric field in these crystals reduces the freezing temperature of water drops.**

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