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An advanced optical microscopy study of surface melting processes at air-ice interfaces

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Surface melting governs various physical properties of snow and ice crystals (e.g. skiing, skating, regelation, etc.) Surface melting and subsequent appearance of quasi-liquid layers on snow and ice crystal surfaces have been studied by many researchers using X-ray diffraction, ellipsometry and atomic force microscopy. However, none of those studies had spacial resolution. Hence non-invasive in-situ observation of surface melting processes is necessary to clarify these processes. In this study, we improved laser confocal microscopy combined with differential interference contrast microscopy (LCM-DIM), by which elementary steps of protein crystals (3-6 nm in height) could be visualized with sufficient contrast levels [1]. Then we have succeeded, for the first time, in visualizing individual elementary steps (0.37 nm in height) and quasi-liquid layer in-situ during surface melting processes.

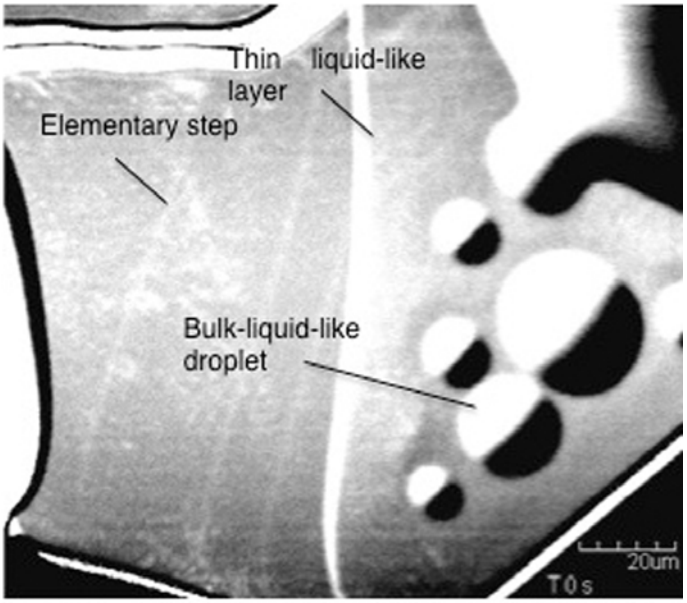

Fig. 1. A photomicrograph of an air-ice interface taken by LCM-DIM.

Figure 1a shows an optical micrograph of an air-ice interface, in which we could observe two types of quasi-liquid layers, in addition to growing elementary steps. One is a bulk-liquid-like droplet, and the other is a thin liquid-like layer. These two layers exhibited features significantly different from ice crystal surfaces. In the conference, we will explain the details of above-mentioned in-situ observation.

1) G. Sazaki, et al., J. Crystal Growth, 262, 536-542 (2004).

Keywords: crystal growth, in situ observation, advanced optical microscopy, snow and ice, surface melting