Gravity-Free ^{4}He Crystals in Superfluid at 150 mK

T. Takahashi, H. Ohuchi, R. Nomura, and Y. Okuda

Department of Physics, Tokyo Institute of Technology, Japan

We have studied ^{4}He crystals in superfluid under microgravity environment produced by a jet plane's parabolic flight. We succeeded in developing a dilution refrigerator for the jet plane experiments and observed the crystals at 150 mK which is much lower than in the previous studies[1,2]. The equilibrium shape of a ^{4}He crystal determined predominantly by the surface free energy under microgravity and its reaction to acoustic waves were observed. Though only the rough surfaces and the *c* facet were identified on the equilibrium crystal in gravity, the *a* and *s* facets newly emerged on the equilibrium crystal under microgravity but no other facets appeared. The crystal stuck to the wall of sample cell during the microgravity period and its shape did not greatly change. This is because the crystal surface was pinned to the side wall of the cell keeping the contact angle between the crystal and the wall constant. The crystal was not able to escape from this metastable configuration. However, when we applied acoustic waves to the *c* facet of the crystal, the *c* facet grew quickly and the crystal was largely deformed. Thereafter, the deformed crystal relaxed to a different shape to adjust to a new boundary condition: the crystal had a contact only with the bottom wall and the *c,a* and *s* facets rearranged their size and shape. Acoustic waves were found to be very effective to manipulate the crystal to study its dynamics under microgravity.

1. T. Takahashi, H. Ohuchi, R. Nomura, and Y. Okuda, "Ripening of Splashed ^{4}He Crystals by Acoustic Waves with and without Gravity" New J. Phys. 14, 123023 (2012).
2. T. Takahashi, R. Nomura, and Y. Okuda, "^{4}He Crystals in Superfluid under Zero Gravity" Phys. Rev. E 85, 030601(R) (2012).

Section: QS - Quantum solids

Keywords: microgravity, ^{4}He crystal, equilibrium shape, acoustic waves