

Melting by Sound in Solid ^4He

Y. Okumura, M. Maekawa, R. Nomura and Y. Okuda

Graduate School of Science and Engineering, Tokyo Institute of Technology,
2-12-1, Meguro-ku, Tokyo, 152-8551, Japan

Solid ^4He in the superfluid is an ideal system to study the intrinsic growth kinetics at the interface and the equilibrium shapes of the crystal because of its high purity and very smooth mass and heat transport through the superfluid. Growth coefficient of solid ^4He in low temperatures is larger than that of the ordinary metals in many orders of magnitude. This high growth rate allows one to observe the equilibrium shapes of the crystal within a second. Many experimental studies in this system confirmed the fundamental phenomena in the crystal growth such as roughening transition, 2D nucleation growth, spiral growth and so on.

We observed the melting of solid ^4He where the sound waves were injected to the rough surface in relatively high temperatures (at around 1K)¹.

Single crystal in the superfluid was grown between two transducers. The sound direction was normal to the solid-liquid interface. Sound pulses were injected from the solid side or liquid side. Almost same amount of melting was observed in both cases. After the sound pulses were turned off the recovery of the surface to the equilibrium height was monitored by the small power sound pulses. The height of the surface was measured in the accuracy of $0.1\mu\text{m}$ by the PSD method. The recovery of the surface were exponential in time. From the time constant of the recovery the growth rates of the surface were obtained. Temperature dependence of the growth rate was consistent with the roton scattering model. The depth of melt is proportional to the sound amplitude and not to the sound power.

To elucidate the mechanism of melting, we propagated the sound parallel to the interface. The melting was also observed but the efficiency was not so good as the case perpendicular to the interface. The general feature is different for both cases.

The further experiment is on going and the possible mechanism will be presented at the conference.

1. Y. Okuda, S. Yamazaki, T. Yoshida, Y. Fujii and K. Matsumoto, *Physica B* **364-366**, 263-264, (1999)