ON THE NATURE OF ELECTRICAL ACTIVITY IN SUPERFLUID HELIUM AT SECOND SOUND EXCITATION

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S u m m a r y

Polarization of superfluid helium (HeII) during the second sound excitation, which was observed by Rybalko (Fiz. Nizk. Temp. **30**, 1321 (2004)), has been explained as the inertial polarization of a dielectric medium $\mathbf{P} \approx -\kappa m_4 \dot{\mathbf{v}}/(4e)$, where κ is the polarizability of HeII, m_4 the atomic mass of ^{4}He, e the electron charge, and $\dot{\mathbf{v}}$ the mechanical acceleration. For the second sound waves, the acceleration is chosen as the time derivative of the relative velocity of the normal component with respect to the superfluid one. The ratio between the amplitudes of temperature and electrostatic potential oscillations in the second sound standing wave has been obtained: $\Delta T/\Delta\varphi = 2ef(T)/k_\mathrm{B}$, where $f(T) = \rho_n(T)/\sigma(T)$, $\rho_n(T)$ is the density of the normal component normalized to the total HeII density, k_B the Boltzmann constant, and $\sigma(T)$ the entropy per ^{4}He atom in units of k_B. The dimensionless parameter $f\,(T)$ is almost temperature-independent in the range $1.3\ \mathrm{K} \leq T \leq 2\ \mathrm{K}$, being close to unity, but it drops rapidly with the temperature decrease at $T < 1.3$ K. Consequently, additional measurements in the low-temperature range have been proposed to elucidate the mechanism of HeII polarization in the second sound wave.