

Collective Modes in Aerogels of Different Porosity Filled With Superfluid Helium

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The velocities of fast and slow collective modes of superfluid He II in 90 %, 94 % and 98 % porosity aerogels were measured by means of low-frequency resonant technique using only piezoelectric transducers. The measurements were made on the acoustic resonator in the frequency range of 100 Hz - 20 kHz and at temperatures 0,5 - 2,5 K. The measured temperature dependences of velocities of both modes are compared with theoretical ones obtained within two-fluid hydrodynamic theory for superfluid helium-aerogel system¹ and with the theory based on approach of Biot² for liquids filling "partially entrained" porous media with taking into account of tortuosity of an acoustic way and porosity³.

It is shown that the experimental data is agree with the theory³. The coefficients of tortuosity are obtained for different porosity aerogels.

It is found that the fast and slow modes in an aerogel are coupled much stronger than the first and second sounds in bulk HeII. This conclusion is supported by the excitement of a slow mode by pressure oscillations.

Evolution of the fast and slow modes with the temperature and porosity variation is established.

1. M. J. McKenna, T. Slaweki, and J. D. Maynard, Phys. Rev. Lett. 66, 1878 (1991).
2. M. A. Biot, J. Acoust. Soc. Am. 28,168 (1956). M. A. Biot, J. Acoust. Soc. Am. 28, 179 (1956).
3. Sh. E. Kekutia and N. D. Chkhaidze, Fiz. Nizk. Temp., 28, 1115 (2002).

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