Possible Formation of Autolocalized State of Quasi-One-Dimensional Surface Electrons in Dense Helium Vapor

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The experimental study is carried out of the mobility of surface electron localized in quasi-one-dimensional (Q1D) conducting channels over liquid helium in temperature range of 1.5 - 3 K. The channels are formed between parallel dielectric threads, where liquid helium surface is curvated by the capillary forces. It is observed that, under temperature increase, the mobility decreases according to kinetic regime of conductivity limited by electron scattering by helium atoms in vapor phase. However, at $T > 2$ K, one observes a rather strong decreasing the mobility relatively that in kinetic regime. Such behavior of mobility can be attributed to a formation of an autolocalized electron state in dense helium vapor accompanying by the appearing a macroscopic regions with non-uniform distribution of vapor density.
The temperature of autolocalized state formation was estimated theoretically basing on the analysis of condition for the occurrence of the minimum in the system free energy. Such an analysis made for both 2D and Q1D surface electrons manifests the decrease of the temperature of the state formation in Q1D in comparison with familiar two-dimensional surface electrons. The formation temperature tends to that in 2D under increase of the curvature radius. The estimated values of the temperature in Q1D are close to those observed experimentally for different curvature radii of helium in conducting channel.