Surface electron transport over structured silicon substrate, limited by ripplon and gas scattering

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In our work quasi-zero-dimensional (Q0D) system of surface electrons (SE) is realized at helium temperature. The system is formed by electrons over superfluid helium placed in cylindrical macropores of a structured silicon substrate. It is shown that the pressing electric field, normal to the electron layer can change essentially the potential well for electrons, depending on curvature of the liquid surface. Conductivity of surface electrons with densities 10^6 to 10^8 cm^{-2} is measured at temperatures $T = 0.5 - 3.0$ K and pressing fields up to 10^3 V/cm. The electron transport along the substrate depends strongly on curvature radius of liquid surface in macropores. If the curvature radius is high and, thereafter the helium film is thin, the electron conductivity has activation nature, typical for the hopping processes. With decreasing the curvature radius the temperature dependence of conductivity becomes smooth. The measurement in gas region (temperature 2-3 K) show that one observes a formation of polaron state of the surface electrons. Also we observe dependence of conductivity vs temperature for 2D and Q1D SE system in gas scattering region and compare with the data for Q0D. It was found that formation of a polaron state for Q0D systems occurs at lower temperature. We also propose theoretical explanation the observed phenomena.

Section: LD - Low dimensional and confined systems

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