Nanoobjects microscopy

IR detector using transitions to the self-localized state of electrons over helium film on the structures substrate

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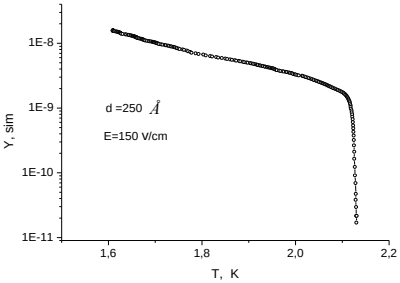
The IR detector is based on stimulate by radiation of the transition from a surface electron state (SE) to surface anion state (SA) on the helium film in the pores of a structured substrate. The transition depends on the thickness of the film, *d*, the electric pressing field, *E*, and temperature, *T* (figure presents conductivity *Y* vs *T*). the ratio of SE/SA – mobilities at low temperature is $(4\,\eta\, e\, E) / (\pi\, \alpha^{3/2}\, m^{1/2})$, here *e* and *m* are charge and mass of electron, and η, α are viscosity and surface tention of the liquid helium. The experimental results agree with the theoretical treatment [1].



The electrostatic modeling of a cylindrical pore along field shown the preferential localization of electrons on the film is inside the pore. The IR image is corresponds to the equipotential relief of the substrate, induced by the contrast of the conductivity of the electrons in the pores. The frequency range and the sensitivity of the detector are determined by the thermal sensibility to the radiation of the nanocovering of the pore walls and the operating temperature. The composition of device is as follows: the porous silicon substrate with reading electrodes (pixels) on the rear side, a collector grid above the substrate and a source of free electrons. Estimates demonstrate that the sensitivity of the IR detector reaches the quantum limit and that exceeds the semiconductor analog, the feature of which is both the formation of wave modes of radiation and the electro-optical effects in a porous substrate.

1. *Shikin V.B., and Monarkha Yu.P*. Free electrons on the surface of liquid helium in the presence of external fields // JETP - 1973. -**75**. – P.751-761.