THRESHOLD AND SPECTRAL CHARACTERISTICS OF THE ELECTRON-HOLE LIQUID CONDENSATION IN DIAMOND UNDER QUASISTATIONARY PHOTOEXCITATION[1]

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Electron-hole liquid (EHL) is a condensed state of non-equilibrium charge carriers in semiconductors. EHL droplets condensation occurs when the temperature is lower and the charge carriers concentration is higher than some critical value, which is individual for every semiconductor material.

The development of high-power solid-state diamond switches would seem to have stopped due to a fundamental limitation – free excitons (FE) do not take part in electric field drift. However, the condensation of free excitons to the droplets of electron-hole liquid, which was detected in diamond at sufficiently high temperatures (up to 200 K) [1, 2] gives a chance for the use of diamond in high current electronics. EHL droplets have a surface charge and are involved in the drift. The speed of sound in diamond is high ~2*10 6 cm/s. This value is an order of magnitude less than the saturated velocity of the carriers in the diamond.

In our experiments we used UV laser pulses with ns-range pulsewidth for creation of high charge carriers concentration, and liquid nitrogen cooling of the samples. The conditions of EHL droplets formation in diamond samples were determined for that case. Earlier, such like data was obtained mostly for femtosecond laser pulses.

Also we managed to demonstrate the effect of EHL droplets on the sample conductivity: in the presence of EHL the current through the sample was up to 2.5 times higher.

REFERENCES

[1] Thonke K., Schliesing R., Teofilov N., et al. // Diamond and related materials. 2000. V. 9. P. 428.

[2] Shimano R., Nagai M., Horiuchi K., Kuwata-Gonokami M. // Physical review letters. 2002. V. 88. No5. 057404.

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