# ELECTRIC CONDUCTIVITY OF NITROGEN-DOPED DIAMOND-LIKE CARBON FILMS: POOL–FRENKEL AND FOWLER–NORDHEIM MECHANISMS

*A.A. Evtukh*

V. Lashkarev Institute of Semiconductor Physics,
Nat. Acad. of Sci. of Ukraine
(*41, Prosp. Nauky, Kyiv 03680, Ukraine;*
*e-mail: evtukh@rambler.ru*)

S u m m a r y

The results of experimental investigations of the electric conductivity of diamond-like carbon (DLC) films on their doping level with nitrogen are presented. Two mechanisms of electron transport through DLC films in the region of high electric fields $E \geq 1 \times 10^6$ V/см, namely the Pool–Frenkel and Fowler–Nordheim mechanisms were revealed. The nonmonotonous dependence of the DLC (a-C:H) film conductivity on the nitrogen doping level was observed. The electric conductivity of films was in the range $(2 \times 10^{-15} - 2 \times 10^{-10})$ $\mathrm{Ohm}^{-1}\mathrm{cm}^{-1}$, and the maximal electric conductivity of films was realized at the nitrogen concentration $\mathrm{N}_2 = 10\%$ in a gas mixture during the deposition. A model is proposed to explain the nonmonotonous dependence of the electric conductivity of DLC films on the nitrogen doping level. According to this model, nitrogen at low concentrations builds in the structural net of a DLC film as a doping $n$-type impurity. This causes the creation of donor levels and a growth of the current. At the same time, nitrogen at high concentrations builds in as an undoping center and causes the creation of deep energy levels (electron traps) in the middle of the DLC film bandgap.