# Semiconductor N-barrier Structures with Periodically Modulated Localization of 2D-bioionics

Ivashchyshyn F.O., Grygorchak I.I., Shvets R.Ya.

*Lviv Polytechnic National University, Lviv, Ukraine*

The formation of nanointerlayers of histidine ($C_6H_9N_3O_2$) in a three-times expended matrix of *InSe* leads to forty-times increase in the real part of the complex impedance and to almost four-times increase in photosensitivity in the direction perpendicular to the nanointerlayers. At the same time, there is observed the effect of photoinduced "negative capacitance". Co-intercallation of water, with inconsiderable increase in *ReZ* in the most low-frequency range, leads to crucial transformation of frequency dispersion of *ReZ*: highly non-monotoneous variation of *ReZ(ω)* in the frequency interval 0.0015-6.5 Hz (the maximum in the neighbourhood of the point 0.02 Hz being 20 times greater than that for water without intercalation) and further decrease of *ReZ* with the increase in frequency. Co-intercallation of histidine by aquous solution of *KOH* leads to essential decrease in *ReZ(ω)* in the whole frequency range investigated and to multi-valued functional relation: *-ImZ=f(ReZ)*. In both cases, the corresponding branches of Nyquist diagram (Fig. 1) manifest processes of storage and retain of charge in N-barrier structures synthesized. However, their mechanisms are, as it follows from data of cyclic voltampermetry (Fig. 2), generally speaking, different. In the first case, it is, in all probability, caused by electronic processes of capturing and retain of carriers by trap centres, but in the structure *InSe<htd+$H_2O$+KOH>*, we have sufficient reason to assert that pseudocapacitive charge storage at interphase interfaces takes place. The confirmation of the latter is made by curves of galvanostatic charge-discharge (inset of Fig.2), which manifect the fact of formation of a monocrystal nanostructured electric energy storage device. Besides, in this case, the combination of super-high value of dielectric permittivity with super-small value of the tangent of the angle of electric losses in infra-low-frequency range can serve as an evidence of the quantum nature of the energy storage. But for *InSe<htd+$H_2O$>* such combination is observed in the range of 1-120 Hz, which is of prospect for creation of quantum capacitors of super-high capacitance.

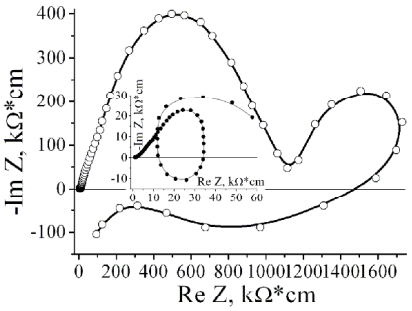


Fig. 1. Nyquist diagram for InSe <htd+$H_2O$> and for InSe <htd+$H_2O$+KOH> (inset) taken in darkness.

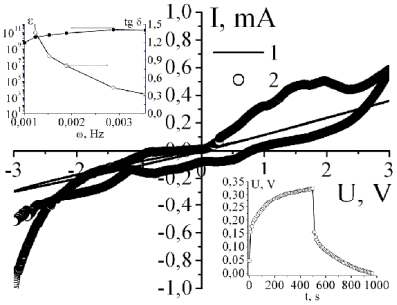


*Fig. 2. CVA of InSe<htd+$H_2O$>(1) and InSe<htd+$H_2O$+KOH> (2). In insets, frequency dependences of tangent of loss angle and of dielectric permittivity (left side); galvanostatic "charge-discharge" with 1 μA current (right side) for InSe<htd+$H_2O$+KOH> are presented.*