The investigation of photoactive J-aggregates of cyanine dyes – carbon nanotubes composite for the application in high-efficiency photoelectric converters

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For the time being one of the promising courses for the science and industry is the development of photoactive devices on the basis of organic materials. For instance, OLED technology enables us to transfer the energy of electricity into radiation by means of using specific polymer luminophor for the goal of enhancing efficiency and durability of the device. However, despite the overall success in that field, there are still many difficulties to confront, e.g. issues with the increase of efficiency should be paid significant attention.

Thus, for solving that problem we suggest to implement the idea of merging two different approaches – the first one is to use cyanine dye J-aggregate composite as a new luminophor material, owing to its outstanding quantum yield properties, and the other – the usage of carbon nanotubes (CNT) as a superior conductive medium for sufficient energy transfer. This method also provides us with the ability of conducting two opposite processes, the transition of light energy into electricity and vice-versa.

The process description: a glass substrate or a silicon chip with pre-deposited contacts is coated with the film of carbon nanotubes (by drop-coating or electrophoresis). In the next stage this layer is coated with the J-aggregates of cyanine dyes (by spin-coating or cross-dielectrophoresis). The aim of CNT arrays is to make good electrical contact and junction with J-aggregates. The final stage is the testing of spectrophotometric and photoelectric properties of the device.

The results are fascinating: conductivity of the structure increased dramatically (in 2-3 orders) when exposed to light (see Figure). Briefly, the structure could be used as an optical sensor and as an excitation-sensitive matrix.

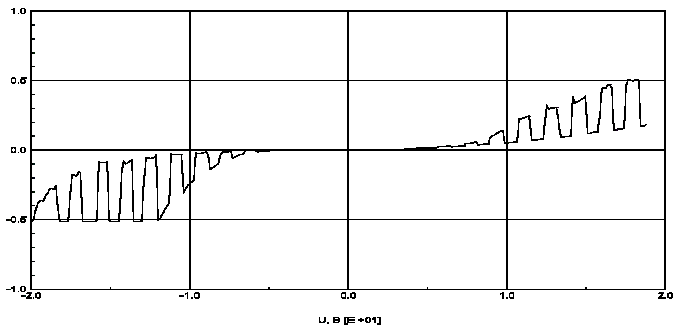

Figure. Dependence of the output current on the light excitation during the measurement. As the measurement takes some time, periodic light exposition results in the shown way.