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Organic Crystals of p - Type TTT2I3 and n - Type TTT(TCNQ)2 as Prospective Thermoelectric Materials for Biomedical Sensors

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Abstract

In this paper, the prospective of using organic nanostructured crystals of p – type TTT2I3 (tetrathiotetracene-iodide) and n – type TTT(TCNQ)2 (tetrathiotetracene-iodide-tetracyanoquinodimethan) as components of thermoelectric biosensors is investigated. A thermoelectric biosensor consists of a p-n module, specially designed to be used as power generator, converting human body heat into small electrical signals, or as local cooler, able to create low temperatures (up to $-20^{\circ}C$) on small surfaces. In biomedical applications, the temperature gradients are low and, in order to obtain as much as possible high electrical signal, materials with enhanced thermoelectric properties are required. Organic crystals of TTT2I3 and TTT(TCNQ)2 were investigated earlier and it was established that these organic compounds are prospective thermoelectric materials if an appropriate optimization of carrier concentration with further purification of the crystal is performed during synthesis. In the following, the electrical conductivity, thermopower (Seebeck coefficient) and the delivered voltage from a p-n module constructed from the mentioned crystals are calculated for different crystals parameters at room temperature. It is established that a single p-n module made of organic crystals can deliver up to 5 mV under a

temperature difference of 20 K around the room temperature if optimization procedures are applied.

Keywords: nanostructured organic crystals, thermoelectric modules, thermoelectric biosensors, tetrathiotetracene-iodide, tetrathiotetracene-iodide-tetracyanoquinodimethan

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