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ELECTRO FREEZING/HEATING FOIL

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Abstract

We propose to formulate an absolutely new paradigm for the solid-state power engineering in the field of the electricity conversion into cold based on the "Freezing Chip" technology. It is the creation of the novel thin-film materials (electro freezing/heating foil) based on the nanostructured dielectrics and semiconductors with the preset optimal parameters and changing a cooling process into a heating process simply by switching the polarity of the supply voltage. We have developed nanostructured semiconductors with a non-conventional mechanism of electron conductivity σ = 10 - 10^3 $Ohm^{-1}\cdot cm^{-1}$. In this case the material heat conduction is of a purely lattice type and is λ = 0,1- 1,0 W/(m·K). Actually, we have developed some kind of an electron heat pipe, but in a nanostructured solid. It allows the principal constraint imposed by the Wiedemann-Franz's law on the efficiency in Peltier effect-based thermo electrical refrigerators to be eliminated. The heat conduction of nanostructured semiconductors having the same electrical conductance as that in the best Bi:Te:Se:-based electrical refrigerators is more than 10-100 times less that offers promise to achieve the energy efficiencies 50%-70 % at 100-300 K and 15-50 % at 10-100 K temperature ranges per one refrigerator stage.