Phase Transitions in Heat Accumulating Organic and Inorganic Materials using NMR-Relaxometry and Thermoelectrometry

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Direct electric energy production in renewal electric energy sources is of great technology relevance and phase transitions (PT) in phase-changing materials (PCM) has here high perspectives. Phase transitions in paraffin and hydrated salts due to their low temperatures of PT can be used at ambient temperatures for transformation of heat of fusion/crystallization in electric current using thermoelectric Seebeck effect of thermoelectricity production using temperature change during the PT .

Using nuclear magnetic resonance relaxometry and thermoelectrometry methods we studied phase transitions (PT) and electric power generation properties of hydrate salt $CaCl_2{\cdot}6H_2O$ and isoparaffin i-$C_{22}H_{46}$. Temperature and time dependences on protons at phase transitions were determined using Portable Relaxometer NMR NP-2 at resonance frequency ν_0 = 14,5 MHz, designed [1] and produced by Construction Bureau of Resonance Complexes Ltd, Kazan and presented at fig.1.

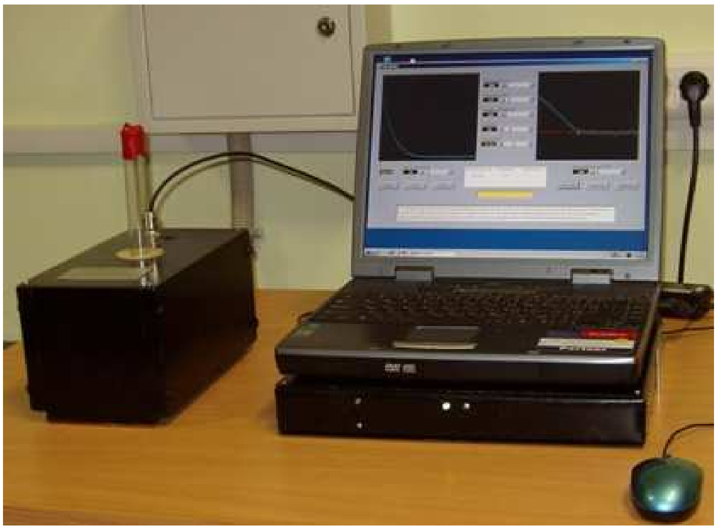

Fig.1. Portable Relaxometer NMR NP-2

Results of measurement of $T_{1A,}\ T_{1B}$ and $T_{2A,}\ T_{2B}$ NMR-relaxation times from inverse temperature $10^3/T$ K in and i-$C_{22}H_{46}$ and TE in salts presented at fig.2,3 and described in [2]. From the position of most effective phase changing inorganic material is $CaCl_2{\cdot}6H_2O$ and it can be effectively used as thermoelectric generator on Seebeck effect and phase transitions [3], presented at fig.4.

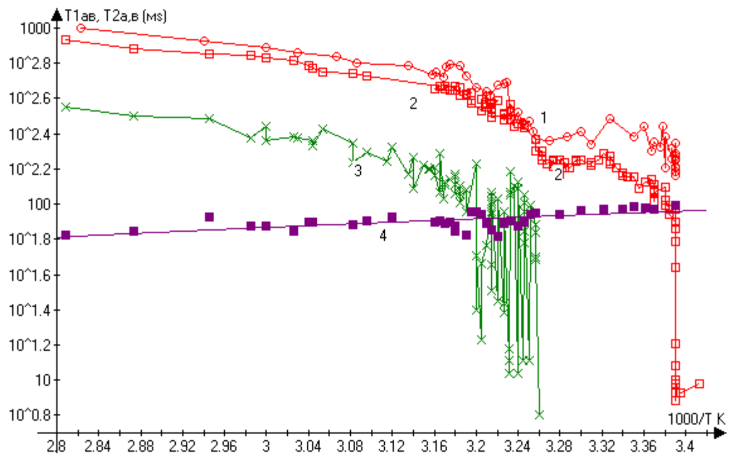

Fig.2. Temperature dependence of spin-lattice T_{1A}(curve 1), spin-spin $T_{2A,B}$ (curves 2, 3) relaxation times from 10^3/T K and P_{2A} proton population (line 4) at cooling of *i*-$C_{22}H_{46}$.

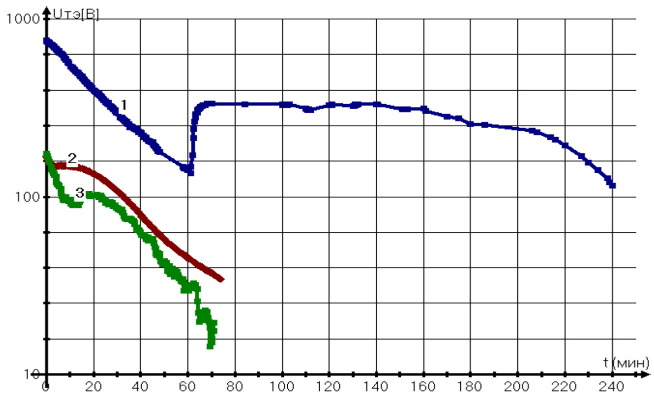

Fig.3. Time dependences of thermoelectricity - electric tension of $CaCl_2 \cdot 6H_2O$ (curve 1), $Na_2S_2O_3 \cdot 5H_2O$ (curve 2) and $CH_3COONa \cdot 3H_2O$ (curve 3) at cooling process from 67°C to 20°C

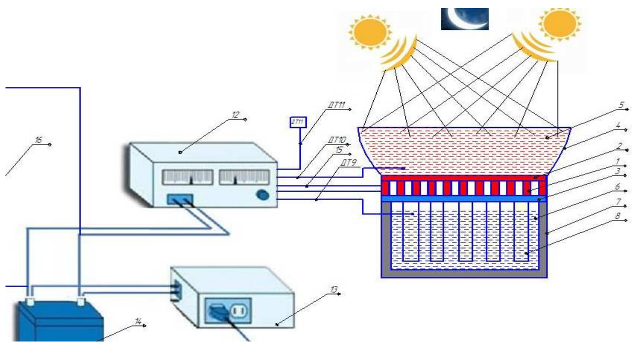

Fig.4 Thermoelectric generator on Seebeck effect and phase transitions

1. Idiyatullin Z.Sh., Kashaev R.S., Temnikov A.N. Patent of Russian Federation on invention №23191138. 4.05.2006.

2. Kashaev R.S.-H., Masiab A.G.N. Phase transitions in some phase changing organic materials studied by nuclear magnetic resonance relaxometry // Chemical and Materials Engineering. 2013, V. 1(3), PP.78-84.

3. Kashaev R.S.-H., Masiab A.G.N. Thermoelectric generator. Patent of RF № 135450 RF, *H01J45/00, F24J2/42.*; publ. 10.12.13, Bulletin of inventions. № 34.