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Development of design and technological methods for creating integrated digital temperature sensors of threshold type based on an Al_2O_3 doped dielectric layer with a nanoscale structure

Type of collaboration

research cooperation / technical cooperation

Key words

sensor, aluminum, threshold, digital, nanotechnologies

State of IPR

Secret know-how

Research objectives:

- Obtaining nanoscale films of anodic aluminum oxide with a given microstructure and composition by electrochemical oxidation of aluminum and simultaneous doping with carbon-containing inclusions of such films during anodizing;
- Obtaining heat-sensitive films of threshold type with the effect of resistive switching.
- Obtaining nanoscale thermosensitive Al2O3 structures of threshold type for creating digital temperature sensors.

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Theoretical base:

Nanostructures of Al_2O_3 localized electronic states are one of the promising materials for creating integrated digital temperature sensors of threshold type. Such components meet all modern requirements for the electronic element base for use in radio engineering.

The principle of operation of the developed digital temperature sensors is based on the thermal excitation of electrons located on traps in a potential well. Filling electron traps in a thin dielectric layer decreases the resistance of such a layer. In turn, once the temperature reaches a threshold value, when the electrons acquire enough energy to leave the electron traps, the resistance of such a dielectric layer increases dramatically.

The application of an electric field increases the energy of the electrons on the electron traps and thus allows you to adjust the depth of the potential well or the threshold value for the temperature at which the electrons leave the potential well.

Integrated components of temperature sensors are currently considered as one of the most promising methods for creating a new generation of non-volatile sensors. Such components meet all the requirements for the element base of microelectronics for use in advanced information technologies.

The main advantages of such components are extremely low energy consumption, high speed of writing, erasing and reading information, and the possibility of using them in neuromorphic systems.

The elements of the temperature sensors use a multi-layer "metal-nanoscale metal oxide-metal" structure and are characterized by the capability to scale, long data retention time, and can meet the criteria of high integration density.