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Abstract

of the doctoral dissertation entitled:

"Copper (II) oxide films obtained by hydrothermal method – growth technology, characterization and potential applications in electronics"

("Warstwy tlenku miedzi (II) otrzymywane metodą hydrotermalną – technologia wzrostu, charakteryzacja i potencjalne zastosowania w elektronice")

The doctoral dissertation was focused on CuO films and encompassed comprehensive research and technological works. These included the development of growth technology, determination of the physical properties and an attempt to demonstrate a memory device based on copper (II) oxide.

The thesis introduces an innovative technique of growth of CuO thin films from aqueous solution utilizing innovative approach to hydrothermal method. It enables the synthesis of copper (II) oxide under mild conditions, i.e. at low temperatures (below 100°C) and at atmospheric pressure, within a remarkably short time. Notably, proposed technology does not require use of any hazardous chemicals and circumvents the requirement for sophisticated and expensive equipment by implementing an open system. Alongside the detailed description of the growth method, a possible mechanism for the formation of CuO films was also presented as well as the possibility of controlling the thickness of the layers in a wide range by modifying the parameters of hydrothermal processes.

The research was focused on investigating the structural and electrical properties of CuO thin films. To achieve this objective, a range of analytical techniques was employed, including SEM, EDX, AFM, XRD, UV-Vis, SCM, KPFM and TUNA, as well as I-V and C-V measurements. Special emphasis was placed on understanding the phenomenon of resistive switching. In addition to identifying the memristor effect in grown films, conducted research provides an in-depth investigation into the mechanisms of resistive switching and the charge transport phenomena that occur during the switching process.

The final stage of research was a demonstration of the possibility of using the produced thin films in RRAM memory structures. The functionality of data storage and the ability to switching between high and low resistance states were visually demonstrated through tunneling atomic force microscopy. Furthermore, data retention capability and the repeatability of results were assessed by analyzing the current-voltage characteristics.

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