THE PROPERTIES OF ATOMIC LAYER DEPOSITED ZIRCONIUM AND COBALT OXIDE NANOLAMINATES

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Fine-grained materials, such as thin ZrO_2 films, differ from bulk materials of the same elemental composition because of the large contribution from the structurally defective surface of nanocrystals in relation to their inner regions. ZrO_2 in nanocrystalline form and in stabilized cubic phase can exhibit enhanced ionic conduction, high dielectric permittivity and be magnetized nonlinearly in external fields. It has been shown that ferromagnetic-like behavior of defective cubic ZrO_2 is possible [1].

In connection with the demand for materials, which could be applied in the novel memories because of their advanced magnetic and electric properties, five-layer structures consisting of alternately deposited ZrO_2 and Co_3O_4 films were constructed in this study. The films were grown by ALD at 300°C from $ZrCl_4$, $Co(acac)_3$ and O_3.

All the films were crystallized in the as-deposited state. The multilayered structure was well-defined with interfaces between constituent, chemically and structurally distinct, layers. The dominant phase observed was the cubic ZrO_2 polymorph. The performance of the laminate films was dependent on the relative content of constituent oxide layers. The magnetization in these films was nonlinear, saturative, and with very weak coercive fields. Electrical measurements revealed the formation of significant polarization versus external field loops, probably markedly influenced by interfacial polarization. Current-voltage measurements implied some tendency towards memristive behaviour with characteristic switching between lower and higher resistance states.

References

1. F. Máca, J. Kudrnovský, V. Drchal, G. Bouzerar, 2008, Magnetism without magnetic impurities in ZrO_2 oxide, Applied Physics Letters vol. 92, 212503.

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