ELECTRICAL PROPERTIES OF TANTALUM NANOTUBE ARRAYS PREPARED BY ELECTRODEPOSITION FROM IONIC LIQUID

ŠIMŮNKOVÁ Helena, KALINA Lukáš, BOUŠEK Jaroslav, MOZALEV Alexander

Brno University of Technology, Brno, Czech Republic, EU

Abstract

Electrodeposition (ED) of tantalum at a room or medium temperature (up to 200°C) using ionic liquids (ILs) has been a challenging process over the last decade. The success of first work on ED of Ta over a planar substrate [1] inspired us to advance the process striving to create an array of well aligned spatially ordered tantalum and tantalum oxide nanostructures via electrodeposition from IL 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl) imide, ([BMP]Tf2N) through nanopores in a thin-film alumina template (100-nm wide and 1-μm long pores of ~10^9 cm-2 population density) prepared by anodizing of aluminium on W/SiO_2/Si substrate. Microscopically flat continuous Ta films (600 nm thick, well adherent to the substrate) and the free-standing arrays of Ta nanotubes filling the alumina pores were achieved via potentiostatic ED technique. XPS analysis revealed the presence of C, Ta, O, Li and F at least in the outer region of the electrodeposited coatings. The coatings annealed at 800°C at 10-5 Pa were fluoride- and lithium-free, and their surface region comprised Ta_2O_5(~67at.%), Ta_2O, Ta and tantalum carbide (~33at.% in total). The I-V characteristics measured across the alumina-templated Ta nanotube array revealed a bipolar resistive switching event in the film, when the film behavior changes abruptly and reversely from a high resistance state (4 G cm^2) to a low resistance state (78 k cm^2) in a low voltage range.

Keywords: Tantalum, nanoarrays, ionic liquids, electrodeposition, electrochemical anodizing

ACKNOWLEDGEMENTS

This research was supported in part by project CZ.1.07/2.3.00/30.0039 of BUT, by GAČR grant no.14-29531S and by project CZ.1.05/2.1.00/01.0012. LITERATURE: [1] N. Borisenko et al., Electrochimica Acta 54 (2009) 1519-1528

Author did not supply full text of the paper/poster.