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Electrochemical control of the oxide film growth on niobium

Michał Stępień and **Krzysztof Fitzner**
AGH University of Science and Technology, Poland

Depending on the thickness of the oxide layer on niobium different properties of this material can be obtained, which can be exploited in sensing, decorative materials, electronic paper and displays. The aim of this work is to produce the oxide layer in the controlled way utilizing electrochemical experiment. The layer of the oxide will be formed by anodization of Nb electrode in acidic aqueous solution. Then, the electrochemical impedance spectrometry (EIS) is used to control the thickness of the growing layer due to the relation: $C = \varepsilon_0 \varepsilon_r \frac{A}{d} \rightarrow d = \frac{\varepsilon_0 \varepsilon_r A}{C}$ where: ε_0 – permittivity of the vacuum; ε_r – permittivity of the oxide film; A – geometric area of the oxide; d – barrier oxide thickness; C – capacitance obtained from EIS after proper choice of the equivalent circuit. However, successful control requires exact knowledge of dielectric constant of niobium oxide. Depending on oxidation conditions, different values of εr can be obtained. Therefore, this value will be verified by using simultaneously EIS and ellipsometric measurements.

Recent Publications:

1. Arsova I et al. (2006) Electrochemical formation of anodic oxide films on Nb surfaces: ellipsometric and Raman spectroscopical studies. Journal of Solid State Electrochemistry 11(2):209-214.
2. Komatsu I et al. (2016) Color change mechanism of niobium oxide thin film with incidental light angle and applied voltage. Thin Solid Films 603:180-186.
3. Potucek R K et al. (2006) Impedance characterization of anodic barrier Al Oxide film beneath porous oxide layer. Journal of the Electrochemical Society 153(8):B304.
4. Richter F et al. (2001) Optical properties and mechanical stress in SiO_2/Nb_2O_5 multilayers. Thin Solid Films 389:278-283.
5. Szymanowski H et al. (2005) Optical properties and microstructure of plasma deposited Ta_2O_5 and Nb_2O_5 films. Journal of Vacuum Science & Technology A 23(2):241-247.

Biography

Michał Stępień graduated MSc from the AGH University of Science and Technology in 2010. He received his PhD degree in 2015 (Synthesis of oxides nanostructures on the surface of selected transition metals) under the guidance of Professor Krzysztof Fitzner. His research interests are based on synthesis and surface modification oxides nanotubes. Now he is a Research Worker in AGH in Department of Physical Chemistry and Metallurgy of Non-Ferrous Metals.

mstepien@agh.edu.pl

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