GADOLINIUM THIN FILMS DEPOSITED BY DC MAGNETRON SPUTTERING UNDER DIFFERENT BIAS

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1. Introduction

In recent years, investigations of magnetism in gadolinium (Gd) have been attracted attention [1]. In particular, this material is used as a reference for magnetocaloric effect [2]. Thus, it is necessary to understand how the deposition conditions affect the properties of gadolinium thin films. A well known way to modify properties of thin films deposited by magnetron sputtering is through applying DC bias voltage in the substrate. In this work, the surface properties of gadolinium thin films are correlated with the applied bias.

2. Experimental

Gadolinium (Gd) thin films were deposited onto silicon substrates by dc triode magnetron sputtering with constant current (0.50 A), cathode power (~180 W), working gas (Ar) pressure (~0.40 Pa) and without external heating. The deposition time was 16 min for each sample. Different substrate bias were applied: floating potential (1.1 V), negative bias (-15, -30 and -50 V), positive bias (5, 10 and 15 V) and grounded sample holder. The film thicknesses, measured by profilometry, were close to 1.0 μm. The samples were also analyzed by X-ray diffraction (XRD) and atomic force microscopy (AFM).

3. Results and Discussions

When positive bias is applied to the substrate, a higher current is measured than for negative bias (Fig. 1). For positive bias, there is a net electron current to the substrate, while for negative bias there is a net ion current. Figure 1 show that current greater than 150 mA can be reached through positive biasing while the current due to negative substrate bias was lower than 6.0 mA for - 70 V.

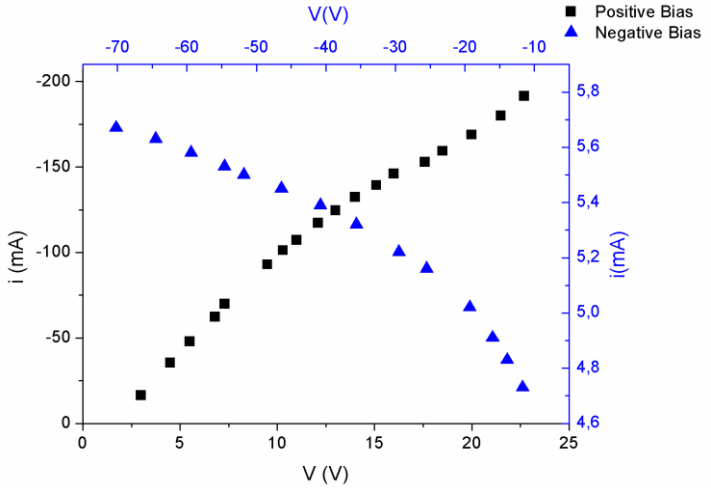

Fig. 1. *Behavior of substrate current as function of applied bias.*

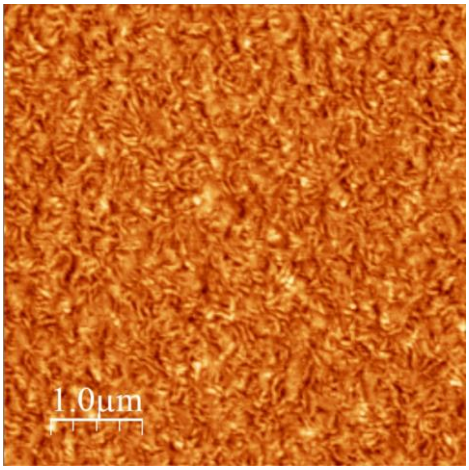

Fig. 2. *AFM image of the sample deposited onto grounded substrate.*

The AFM images show that the film surface has elongated "grains" (Fig. 2). No significant difference in morphology is observed for the different bias. The XRD spectra present the same characteristics for all samples. Thus, the results show that the bias has no significant effect in surface morphology and crystallinity of the films.

4. References

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[2] K.P. Shinde, B.B. Sinha, S.S. Oh, H.S. Kim, S.K. Baik, K.C. Chung, D.S. Kim, S. Jeong, J. Magn. Magn. Mater, **374**, 144-147, (2015).

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