FIRST INTERNATIONAL CONFERENCE ON ELECTRON MICROSCOPY OF NANOSTRUCTURES

ELMINA 2018

ПРВА МЕЂУНАРОДНА КОНФЕРЕНЦИЈА О ЕЛЕКТРОНСКОЈ МИКРОСКОПИЈИ НАНОСТРУКТУРА

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FIRST INTERNATIONAL CONFERENCE

ELMINA 2018

PROGRAM & BOOK OF ABSTRACTS

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FIRST INTERNATIONAL CONFERENCE
ELMINA 2018
Program and Book of Abstracts

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At the beginning we wish you all welcome to Belgrade and ELMINA2018 International Conference organized by the Serbian Academy of Sciences and Arts and the Faculty of Technology and Metallurgy, University of Belgrade. We are delighted to have such a distinguished lineup of plenary speakers who have agreed to accept an invitation from the Serbian Academy of Sciences and Arts to come to the first in a series of electron microscopy conferences: Electron Microscopy of Nanostructures, ELMINA2018. We will consider making it an annual event in Belgrade, due to this year's overwhelming response of invited speakers and young researchers. The scope of ELMINA2018 will be focused on electron microscopy, which provides structural, chemical and electronic information at atomic scale, applied to nanoscience and nanotechnology (physics, chemistry, materials science, earth and life sciences), as well as advances in experimental and theoretical approaches, essential for interpretation of experimental data and research guidance. It will highlight recent progress in instrumentation, imaging and data analysis, large data set handling, as well as time and environment dependent processes. The scientific program contains the following topics:

- Instrumentation and New Methods
- Diffraction and Crystallography
- HRTEM and Electron Holography
- Analytical Microscopy (EDS and EELS)
- Nanoscience and Nanotechnology
- Life Sciences

To put this Conference in proper prospective, we would like to remind you that everything related to nanoscience and nanotechnology started 30 to 40 years ago as a long term objective, and even then it was obvious that transmission electron microscopy (TEM) must play an important role, as it was the only method capable of analyzing objects at the nanometer scale. The reason was very simple - at that time, an electron microscope was the only instrument capable of detecting the location of atoms, making it today possible to control synthesis of objects at the nanoscale with atomic precision. Electron microscopy is also one of the most important drivers of development and innovation in the fields of nanoscience and nanotechnology relevant for many areas of research such as biology, medicine, physics, chemistry, etc. We are very proud that a large number of contributions came from young researchers and students which was one of the most important objectives of ELMINA2018, and which indicates the importance of electron microscopy in various research fields. We are happy to present this book, comprising of the Conference program and abstracts, which will be presented at ELMINA2018 International Conference. We wish you all a wonderful and enjoyable stay in Belgrade.

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Formation of Ag Nanoparticles in CrN by Using Ag Ion Implantation and Thermal Annealing

Mirjana Novaković[1], Maja Popović[1], Emanuel Schmidt[2], Philipp Schöppe[2], Miodrag Mitrić[1], Nataša Bibić[1], Carsten Ronning[2], Zlatko Rakočević[1]

[1] *University of Belgrade, Institute of Nuclear Sciences VINČA, 11351, Belgrade, Serbia*

[2] *Institute of Solid State Physics, Friedrich Schiller University Jena, Max-Wien-Platz 1, D-07743, Jena, Germany*

In the recent years, there has been a great interest in metal nanoparticles (NPs) embedded in different host matrices due to the wide range of their potential applications [1,2]. Methods, which are the most frequently used for the production of the nanocomposites with metal nanoparticles, are in situ doping during growth of the material or subsequent ion implantation. Experiments involving ion implantation are commonly performed at elevated temperatures or they are followed by high temperature annealing or high-energy (MeV) irradiations [3]. In this study we examine the influence of silver ion implantation and subsequent annealing on the behavior of CrN layers, where the variation of these parameters is expected to play an important role for the formation of Ag nanoparticles. As it will be seen from the results, Ag nanoparticles are formed for the particular used set of experimental parameters of 2×10^{16} ions/cm^2 and 700 ºC annealing temperature.

CrN films thickness of ~280 nm deposited by means of d.c. reactive ion sputtering on commercial Si (100) wafers were implanted with silver ions with incident ion energy of 200 keV to the fluences of 0.5-2×10^{16} ions/cm^2. For such an incident ion energy, the SRIM code [4] gave an average ion implanted depth of R_P=40 nm with a straggling of ΔR_P=14 nm. Subsequent to the implantation the films were annealed for 2 h either at 200 ºC and 400 ºC or at 700 ºC. Lamellas for transmission electron microscopy (TEM) were prepared via focused ion beam (FIB) using a FEI Helios Nanolab 600i dual beam system. High-resolution TEM microscope TALOS F200X was used for characterization of the samples.

A high-magnification image and corresponding EDS elemental mapping of CrN film implanted to the fluence of 2×10^{16} ions/cm^2 and annealed 2h at 700ºC is presented in Fig. 1. The HRTEM image shows the inhomogeneous depth distribution of the NPs. The smaller Ag nanoparticles are found in the top sublayer, while the largest ones are in the bottom sublayer, at a depth corresponding to the maximum Ag distribution in the sample. The NPs size was measured in the cross-section image and the resulting size distribution is shown in the inset of Fig. 1a. The maximum particle diameter is 14 nm, but most of them are very small. In fact, 90% of the counted Ag nanoparticles were less than 5 nm in diameter. Fig. 1b presents elemental color mapping of the rectangular area taken from the cross-sectional image. Chromium, nitrogen, and silver are presented in different colors: Cr (green), N (deep blue) and Ag (sky blue). The Figure reveals the uniform spatial distribution of Cr and N in the film area, whereas the silver is entirely located within the nanoparticle areas.

It is demonstrated that the Ag metallic nanoparticles, with a spherical shape and grain diameter up to 14 nm were formed within the CrN films after silver ions implantation. The particles are inhomogenously distributed through the layer and the largest ones are found at a depth corresponding to the projected range of Ag ions. The results of this study are interesting towards developing radiation tolerant materials based on multiple layered structures.

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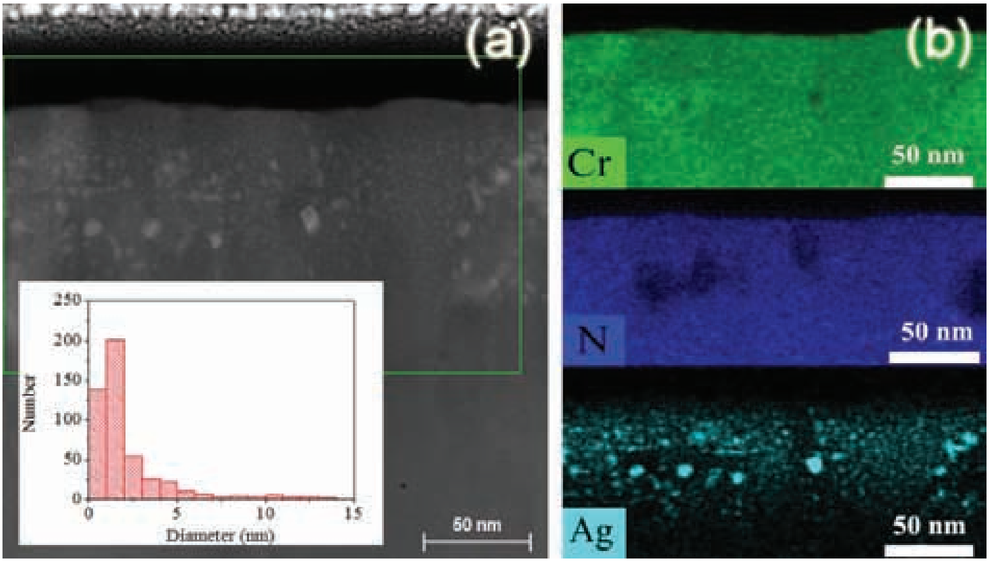

Figure 1. (a) High-magnification cross-sectional image of subsurface of CrN layer implanted to the fluence of 2×10^{16} ions/cm^2 and annealed 2h at 700°C with the particle size distribution in the inset and (b) EDS element color mapping.

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