В качестве адсорбционных центров нами выбирались атомы слоев и центры гексагонов. Молекула воды пошагово приближалась к выбранным центрам с шагом 0,1 Å. В результате были построены профили поверхности потенциальной энергии взаимодействия слоев и молекулы H2O. Определены энергии адсорбции и расстояния адсорбции для различных положений (рис. 1).

Для борного слоя расстояние адсорбции ($R_{ад}$) составляет 2,64 Å и 2,70 Å для положений над атомом и над центром гексагона соответственно, при этом энергия адсорбции ($E_{ад}$) для обоих вариантов составляет приблизительно 7,45 эВ. Также был произведен анализ изменения ширины запрещенной зоны комплексов (Eg) в зависимости от наличия водной молекулы на их поверхности.

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FABRICATION AND CHARACTERIZATION OF Co NANOWIRES EMBEDDED INTO THIN ANODIC ALUMINA FILM

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In this work we fabricated an array of Co nanowires embedded into a relatively thin anodic alumina matrix placed on top of functional ferromagnetic thin film. Magnetic properties of such a hybrid magnetic structure were studied and compared to Co nanowires grown in a bulk anodic alumina template.

Magnetic nanowires are representative of a novel class of magnetic materials with shape-driven properties, which includes 3D curved magnetic nanostructures and nanoscale patterned films [1]. Nanowires attract much attention due to multiple prospective applications in magnetic sensors and biotechnology [2], novel magnetic memory [3] as well as fundamental research [4]. Here we synthesized and studied short Co nanowires embedded into a thin alumina film deposited on top of functional magnetic film. Such array of short magnetic nanowires (or nanopillars) can be considered as a promising candidate for multiple applications ranging from magnetic memory and logic to magnetic biosensor.

Thin conducting film of $Fe_{20}Ni_{80}$ (40 nm) (magnetically active layer) or Cu (40 nm) (reference layer) and Al (500 to 800 nm) were sequentially deposited onto the glass substrate by magnetron sputtering. The aluminum layer was anodized by two-stage process using electrochemical cell at room temperature and 40 V. Thin Fe20Ni80 or Cu layer was used as an anode, Pt grid was used as a cathode, and 0.5 M aqueous solution of oxalic acid was used as an electrolyte. Barrier layer thinning protocol was used so AC electrodeposition can be used without the need for a complete oxide layer removal [5]. Co nanowires were grown using an electrolyte containing CoSO4 as a precursor and boric acid to adjust the pH. Morphology of the samples was studied using scanning electron microscopy (SEM). Magnetic properties were studied using vibrating sample magnetometer and magnetooptical Kerr-microscope.

First of all, we ensured that the conducting thin $Fe_{20}Ni_{80}$ layer can be used as stopping layers for complete anodization of Al. Comparison of hysteresis properties measured on a single-layer $Fe_{20}Ni_{80}$ film and $Fe_{20}Ni_{80}$ layers with partially or completely anodized top Al layer revealed that no magnetic properties change can be detected if Al is anodized partially, whereas significant coercivity rise was detected if Al layer is anodized completely. At the same time no significant degradation of $Fe_{20}Ni_{80}$ magnetization was detected even if Al is anodized completely, which indicates that the process of anodization stops at the interface. The fully anodized aluminum film deposited onto the $Fe_{20}Ni_{80}$ layer is shown in Fig. 1.

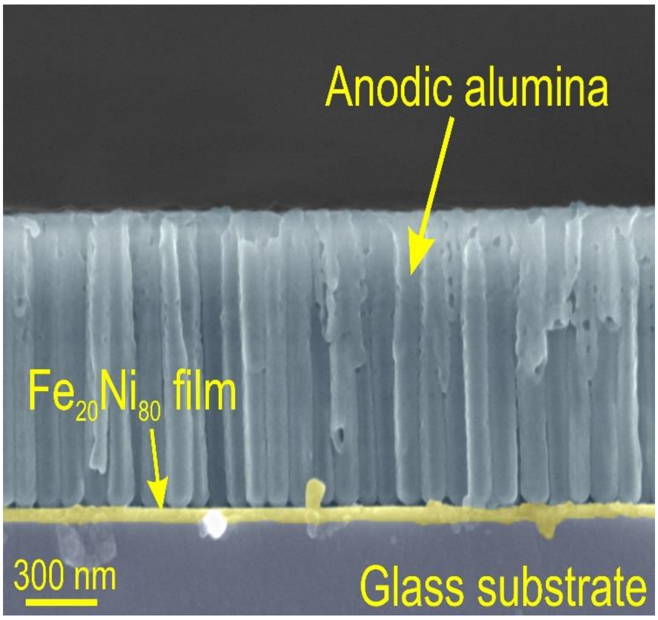

Рис. 1. SEM image obtained on a cleavage of porous anodic alumina film on top of a thin $Fe_{20}Ni_{80}$ layer. The prolonged cylindrical tubes were used for subsequent electrodeposition of Co nanowires. False colors are added for enhanced contrast between different materials

For comparison of magnetic properties of Co nanowires fabricated at different conditions we used magnetic nanowires deposited into bulk anodic alumina foils and into the anodic alumina film on a thin $Fe_{20}Ni_{80}$ or Cu layer. The last one allowed us to perform a direct comparison with no additional magnetic respond from a magnetic film, whereas nanowire array obtained on the $Fe_{20}Ni_{80}$ film was used to take into account the magnetostatic interaction between the magnetic film and nanowires. As magnetic moment the thin film was relatively weak, Kerr microscopy was used for more in-depth study of hysteresis properties and magnetic domain structure on $Fe_{20}Ni_{80}$ film.

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