STUDY OF PIEZOELECTRYCITY IN STRUCTURES BASED ON NANOFIBROUS ZnO LAYERS AND POLYSILANE

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Absract–*Zinc oxide films were deposited by method rf magnetron sputtering in a mixed environment of oxygen and argon on two types of substrates, glass and silicon substrates with different orientations, by varying the deposition parameters in order to obtain high-quality ZnO nanostructured layers. An atomic force microscope was used to measure the piezoelectricity in nanofibrous layers and poly [methyl (H) silane]. The interaction between the type of semiconductor /poly[methyl(H)silane] and the applied electric field has proved that thea given structures are piezoelectric materials useful for fabrication of optoelectronic devices.*

1. INTRODUCTION

Atomic Force Microscopy (AFM) is a very important instrument for science and modern technologies thanks to its high resolution. Despite remarkable progresses of AFM technology, the performance is still limited by the low speed of lateral scanning, but this doesn't limit the measures. The improvement of the operational speed is required for the new applications such as high scanning speed of AFM, scanning probe lithography (SPL) [1, 2]. Mechanical and electrical coupling phenomena are characteristic to some organic, inorganic, and biological systems. One of the simplest example of linear electromechanical coupling is the piezoelectricity. Among the tetrahedral coordinated wurtzite semiconductors, ZnO is a typical example[3]. ZnO can be grown in a reproducible way in a variety of nanostructures e.g., nanowires, nanorings, nanofibrous, platelet circular structures, Y-shape split ribbons and crossed ribbons. This variety can be unique for many applications in nanotechnology.[4] This makes ZnO a technologically important material in many practical applications that requires a large electromechanical coupling. The growth methods and electrical and mechanical properties of ZnO nanostructures have been extensively studied and by now they are well known to the research community. On the other hand, ZnO nanowires have demonstrated success in various applications *e.g.* optoelectronics, biosensors, resonators, electric nanogenerators and nanolasers. The combination of inorganic and organic materials is a priority research today. Polysilanes are a distinct class of conjugated polymers where the spatially delocalized band-like structure involves σ−electrons and is similar to the alternating single and double bonds in polyenes.[5, 6] This peculiar structure allows the motion of the charge carriers within the conjugated backbone and gives them semiconductive and NLO properties [7, 8]. Polymers such as polyhydrosilanes are a relatively new class of polyorganosilane copolymers containing methylhydrosilyl segments.[9, 10] Polyhy-drosilanes could be synthesized using a Wurtz-type reductive coupling reaction of methyl(H) dichlorosilane with organodichlor-osilanes in heterogeneous systems of metallic sodium dispersion in toluene[11, 12]. Through polyhydrosilanes the domain of unconventional structures synthesis was developed towards the discovery of new reaction procedures and mechanisms [13-16]. In this report, we present the results of the study of piezoelectricity using ZnO nanolayers of different thicknesses grown on different substrates.

2. EXPERIMENTS

Zinc oxide films were deposited by method of *rf* magnetron sputtering in a mixed environment of oxygen and argon on two types of substrates, glass and silicon substrates with different orientations, by varying the deposition parameters in order to obtain high-quality ZnO nanostructured layers. The rf magnetron sputtering apparatus consists of a cylindrical plasma generation chamber and deposition chamber. The plasma generation chamber is surrounded by an electromagnet. Cylindrical metallic zinc with 99.9% purity was used as the target of 50 mm diameter and 4 mm thick. The vacuum of the sputtering system was evacuated using a primary and turbomolecular pump to a pressure below 10^{-5} mbar. Magnetron sputtering was carried out in oxygen and argon mixed gas atmosphere by supplying rf power at a frequency of 13.56 MHz. The flow rates of both argon and oxygen were controlled

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