SELF-ASSEMBLY ZnO NANOSTRUCTURES FOR NANOSCALE DEVICES APPLICATIONS

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***Abstract* – We demonstrate a synthetic approach to self-assembly ZnO nanostructures on flat, spherical and curved surfaces. Self-assembly of ZnO nanorods was performed in aqueous solution. The effects of electric field, biopolymer assistance, as well as grow parameters, like temperature and molar ratio are studied. The nanostructures were investigated by SEM, XRD, EDX and TEM. All diffraction peaks of the ZnO nanostructures are well indexed to the hexagonal (space group $P6_3mc$) zinc oxide. Self-assembly ZnO nanostructures showed an encouraging characteristic and can be applied in future nanoscale fabrication. The self-assembly, as a tool to manipulate objects at nano-scale, offer possibility to be used in fabrication of electronic and photonic nanodevices applications.**

***Keywords*:** *self-assembly, ZnO nanorods, nanoscale devices, nanostructures.*

1. INTRODUCTION

As the limits of photolithography are rapidly approached and continued increases of the density of electronic devices on chip have stimulated the development of novel approaches and changes in the way electronic nanostructures are designed and operated [1]. The controlled fabrication of very small structures at scales beyond the current limit of photolithographic techniques is a technological goal of great practical and fundamental research [2,3]. In this context, self-assembly is a powerful mechanism, a reusable engineering concept which became a control mechanism for the bottom-up manufacture of complex systems. Self-assembly is the basic principle which produces structural organization. Understanding how self-assembly systems are produced in nature will be an enormous step forward in technology of microelectronics. Detailed studies of self-assembly will enable producing faster electronic devices, while current chip manufacturing processes are limited. Advances of systems design that exhibit self-assembly properties have been reported [4].

At the same time, has been observed increasingly research interests for one-dimensional nanostructures such as nanorods and nanowires due to their importance to understanding fundamental physical phenomenon and to their exciting applied physics as functional nanobuilding units for new generations of nanodevices. Various nanomaterials have been synthesized and studied. Among them, zinc oxide (ZnO) is a semiconductor material with various configuration architectures much richer than of any other known nanomaterial [5,6]. It's properties assures conditions for formation of a richest micro/nanostructure diversity in comparison with other materials [1]. ZnO nanorods with their high carrier mobility serve as direct conduction pathways for excitons. In applications of nanomaterials-based devices, fabrication process represents the most important step in their realization. Thus, it is necessary to be mentioned, that have been developed different methods, techniques for synthesis of nanomaterials. The most developed techniques and detailed described in scientific literature are lithography, mechanochemistry, and more recently self-assembly [7,8], etc. Thus, assemble ZnO nanoscale building blocks into functional nanostructures is an important and very difficult task. In this paper, we report the synthesis and characterization of zinc oxide nanostructures, self-assembly and perpendicular oriented nanorods forming arrays, grown on a silicon wafer by a chemical method. The factors, influences the formation of ZnO arrays, were discussed based on the experimental results.

2. EXPERIMENTAL PART

2.1. Synthesis

Zinc sulfate and sodium hydroxide or ammonia from Fisher Scientific was mixed until complete dissolution. The aqueous complex solution was loaded into a reactor and a piece of cleaned silicon wafer was placed in the aqueous solution. To study the effect of the electric field, of the temperature and growth parameters on nanoarchitectures, the reactor was transferred into respective condition and positioned on