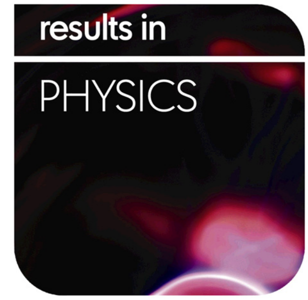
Accepted Manuscript



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PII: S2211-3797(17)32487-7
DOI: https://doi.org/10.1016/j.rinp.2018.02.048
Reference: RINP 1280

To appear in: *Results in Physics*

Received Date: 14 December 2017
Revised Date: 21 February 2018
Accepted Date: 21 February 2018

Mechanical behavior enhancement of ZnO nanowire by embedding different nanowires

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A B S T R A C T

In this work, we employed commercial finite element modeling (FEM) software package ABAQUS to analyze mechanical properties of ZnO nanowire before and after embedding with different kinds of nanowires, having different materials and cross-section models such as Au (circular), Ag (pentagonal) and Si (rectangular) using three point bending technique. The length and diameter of the ZnO nanowire were measured to be 12280 nm and 103.2 nm, respectively. In addition, Au, Ag and Si nanowires were considered to have the length of 12280 nm and the diameter of 27 nm. It was found that after embedding Si nanowire with rectangular cross-section into the ZnO nanowire, the distribution of Von Misses stresses criterion, displacement and strain were decreased than the other nanowires embedded. The highest stiffness, the elastic deformation and the high strength against brittle failure have been made by Si nanowire comparison to the Au and Ag nanowires, respectively.

***Keywords*: Nanowires, Material effects, Mechanical properties, Brittle failure**

Introduction

Owning to the unique properties such as anisotropic structures, small diameter and large in surface to volume ratio, nanowires have widely applied in many different fields. In addition, it has been seen that there are significant differences between properties of nanomaterials in comparison with properties of bulk materials since the size of nanomaterials decreases to be close to the atoms size, so they have received a growing interest owing to their superior properties. Therefore, mechanical properties of volume-confined materials at nanoscale have different behaviors than those of conventional bulk samples. For the specific case of ZnO, brittle behavior was observed by the bulk material with maximum deformations well below 1%, which hinders applications. On the contrary, a ductile behavior was obtained by ZnO nanostructures which are capable of withstanding large elastic deformations up to 15% without breaking. Furthermore, such strengthening size-effect was led to ZnO nanostructures experience a marked stiffening size-influence for smaller sizes [1,2]. Thus, in recent years, many attempts have been

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