Experimental and Theoretical verification

of a silicon micro-beam bending response

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ABSTRACT

Experiments of materials in micro and nanoscales have shown that their behavior under bending departs in many cases from the classical elasticity Euler-Bernoulli theory. This deviation has been seen that usually is due to the size of the structure which affects the material properties.

In this study, a silicon micro-beam is examined, using the technique of Atomic Force Microscope (AFM) and Raman spectroscopy. These techniques have a very wide range of use in science of engineering, medicine, biology and physics. Specifically, the applications of AFM and Raman spectroscopy are discussed in this paper. A main characteristic of these methods, is the fact that gives us the ability to conduct experiments of high accuracy in micro and nanoscale.

In order to examine the silicon micro-beam, AFM applies a constant force on the surface of the free end of the beam while Raman laser scanning an area along the beam as shown in Figure 1. The ultimate goal is to detect the strains and deformations and find out their maximum values. At this point a theoretical analysis is important and necessary in order to evaluate the experimental results.

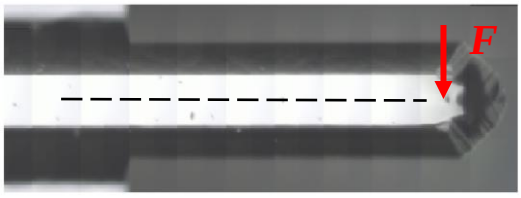

Figure 1: Illustration of the scanning area of the micro-beam in Raman and the applied force

In this paper we analyzed the Euler- Bernoulli beam theory for small deformations and the mathematical formulas, which are required to result in a main formula for the calculation of strains. The results of Euler- Bernoulli beam theory as well as the experimental results are represented in a form of a graph (strains- beam position) and the conclusions of them are discussed in the end of this paper.

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