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MODERN APPROACH TO THE NANOTECHNOLOGY EDUCATION

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Abstract: *Nanotechnology is technology of the 21st century. Nanotechnology education is now a domestic and international challenge to solve the problems facing society, while simultaneously making life and the future better. But, public opinion showed controversy between science-industrial activity and communication with consumers. Thus, modern nanotechnology curriculum should include integrate, multidisciplinary, disparate and life-long concepts into curricula matrices and teaching activities through all educational stages to face the educational lack in this area internationally.*

Key Words: Education/Nanotechnology/Curriculum

1. INTRODUCTION

Nanotechnology present manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest description of nanotechnology[1, 2] referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products (molecular nanotechnology). Today, many different definitions of nanotechnology are developed. The most applicable definition is established by the National Nanotechnology Initiative, which defines nanotechnology as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers.

Nanotechnology is a very interdisciplinary field, including surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, molecular engineering, etc.[3]. The applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale.

Scientists currently debate the implications of nanotechnology. Nanotechnology is capable to create many new materials and devices with a vast range of applications, such as in nanomedicine, nanoelectronics, biomaterials energy production, consumer products, food and agriculture. On the other hand, nanotechnology raises many of the same issues as any new technology, including concerns about the toxicity and environmental impact of nanomaterials[4], and their potential effects on global economics, as well as speculation about various doomsday scenarios.

Education is one of the most effective systems to change people's behavior. Progressive institutes and universities have established nanotechnology education initiatives in order to get modern specific knowledge for nanotechnology future.

According to the importance of nanotechnology education, researchers have studied the integration of nanotechnology concepts into curriculum and teaching activities through various educational levels[5].

This paper discuss modern concepts of nanotechnology curriculum which integrate mathematical models, visual simulations and various instructional strategies

2. A MODERN APPROACH

2.1 Mathematical models

There are four types of 2D or 3D molecular dynamics models available for simulating nanosystems.

2.1.1 The all-atom molecular dynamics

This model present every single atom as an independent particle that interacts with one another through the van der Waals forces and electrostatic forces and every molecule as a group of atoms connected through bond-stretching, angle-bending, and dihedral torsion forces (Figure 1.).

The model is used when an accurate description of the chemical structure of a nanosystem is required[6].

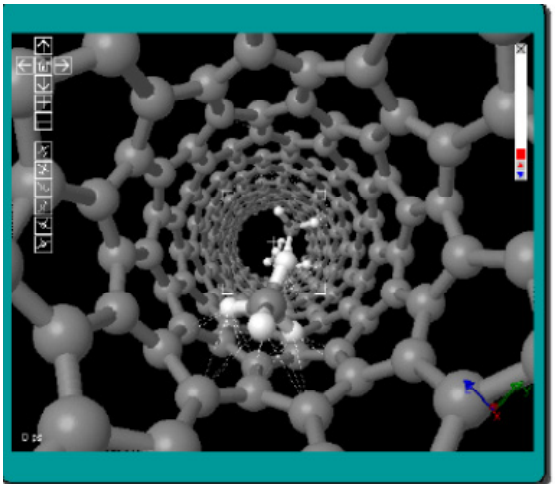

Figure 1. An all atom molecular dynamics simulation of motion of methane molecules moving through a carbon nanotube [6].

2.1.2 The coarse-grained molecular dynamics

This approach is used for large biological systems. A coarse-grained model reduces the number of degrees of freedom of a system by keeping important features and removing the relatively trivial details[6].

2.1.3 The soft-body dynamics for biomolecules

The soft body dynamics present molecular surfaces as a network of particles connected by elastic constraints.

2.1.4 Quantum dynamics

Quantum dynamics models are used for modeling quantum effects, important for the nanoscale world. It is responsible for novel properties of nanostructures (nanoparticles, quantum dots etc.). Fig. 2 shows a 2D simulation of quantum waves contained in a circle with a finite barrier height.

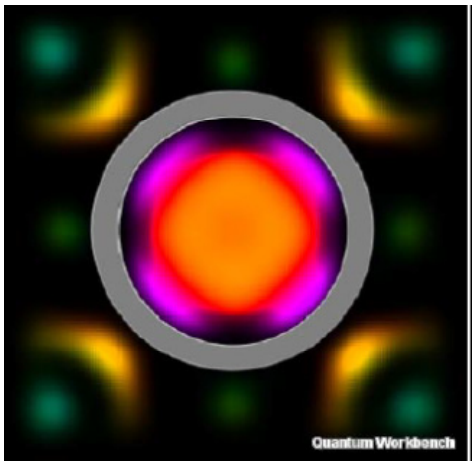

Figure 2. The snapshot of the quantum wave in a curricular container with a finite barrier height [6].

2.2 Visual simulations

Visual simulations in nanotechnology education significantly power mathematical models.

The most commonly applied visual simulations cover following topics:

- the basic science about electrons, atoms, and molecules,
- thermodynamics and statistical mechanics
- nanoelectronics
- virtual nanotechnology experiments and nanosystem designs

2.3 Instructional strategies

Teacher-students interaction and student-student collaboration is very important for amplification the power of visual simulation. To provoke the best impact of visual simulation two strategies should be used:

- visual simulations are assisting lectures
- visual simulations are used as virtual experiments.

3. CONCLUSION

This paper proposed a modern nanotechnology curriculum consisting of integrate multidisciplinary and disparate concepts into curricula matrices. The public opinion showed knowledge gap between science and researchers on one side and consumers on another. Thus, it is very important that modern nanotechnology curriculum shows all benefits and potential risks of nanotechnology applications.

The paper showed that best way to teach students nanotechnology is to use mathematical models and visual simulations in combination with student-student and teacher-student interaction.

4. REFERENCES

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