

INTERACTIVE NANOVISUALIZATION FOR SCIENCE AND ENGINEERING EDUCATION

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Abstract

The relationship between the structure of materials, especially at the atomic/molecular level, and their properties as well as the changes they undergo, is one of the central in science. It is well known that students have difficulty with both the application of atomic/molecular models to the explanation/prediction of the behavior of materials as well in the prediction of properties and phenomena at the macroscale based on the micro/nanostructure. There is also a paucity of appropriate resources for teachers to help them to effectively convey these concepts. We have developed innovative educational approaches that will help students make these connection and employed several strategies including, the integration of advanced telecommunication technology and analytical instrumentation (e.g. scanning probe microscope - SPM) with science education, and use of interactive and discovery-based educational experience that can be accessed and shared on a global basis. The Interactive Nano-Visualization for Science and Engineering Education (IN-VSEE) project brings sophisticated, yet user-friendly, state-of-the-art imaging technology and instrumentation that are traditionally available only at elite research centers into any college classroom. This project has created a consortium of university and industry researchers, community college and high school faculty and museum educators with a shared vision of building an interactive World Wide Web (WWW) site (<http://invsee.asu.edu>) to develop such an educational paradigm. The integration of nanoscience concepts into the curriculum also allows one to convey the excitement at the forefront of scientific research to students at upper-division high school and lower-division college levels, which are critical transition points in a student's educational career.

The goals of IN-VSEE are to

- Increase student understanding of structure, composition, and properties of materials across size scales with examples that cut across traditional disciplinary barriers.
- Reinforce fundamental concepts appearing in the curriculum and connect math with science.
- Educate students in the principles, execution, interpretation, and rational design of experiments.

IN-VSEE exploits the potential to teaching students about fundamental concepts, to integrate learning across traditionally separated disciplines and to provide them with the unique opportunity of participating in an exciting research projects as a part of their education. Our experience has clearly shown that the hands-on approach, the high visual impact, the interactive computer interface, ability to learn about surfaces, their properties and even manipulate them at the atomic level, captures and maintains the undergraduate student's interest.

This project at Arizona State University (ASU) has developed several resources- a remotely operable SPM, a visualization gallery of images, animations, and interactive activities, and a number of educational modules designed around the theme of materials. IN-VSEE will address the need for developing appropriate interactive educational modules that integrate concepts across size, scale, disciplines, methodologies and phenomena and emphasize nanometer scale imaging, structure-property relationships and structure-function correlation.

Brief overviews of selected modules, images, interactive activities, and animations will be shown. Examples include: allotropy of carbon, epitaxial growth of gold thin-films, the self-assembly of polystyrene nanospheres, and biological structures such as cell walls and DNA.