

Interactive Nano-Visualization for Science and Engineering Education

V. Pizziconi¹ (vincent.pizziconi@asu.edu), A. Garcia¹, B. Ramakrishna², W. Glaunsinger³,
A. Razdan⁴, E. Ong⁵, K. Hintze⁵

¹ Chemical, Bio & Materials Engineering Department, ² Center for Solid State Sciences, ³ Department of Chemistry and Biochemistry, ⁴ Partnership for Research in Stereo Modeling, ⁵ The INVSEE Project, Arizona State University, Tempe, AZ. 85287

Abstract – A novel, web-based Interactive Nano-Visualization for Science and Engineering Education (IN-VSEE) initiative is currently under development at Arizona State University and collaborating institutions that offers asynchronous distance learning of material systems remotely over the WWW. IN-VSEE exploits advanced telecommunications to facilitate remote operation of scanning probe instruments over the web directly from the classroom. The IN-VSEE multidisciplinary initiative can be used to reinforce biomaterials science and engineering concepts, as well as for training bioengineering students interested in understanding and exploiting man-made and naturally derived biomaterials at the micro- and nanoscale.

I. INTRODUCTION

The need for preparing students to more fully understand and exploit material systems at smaller and smaller scales presents a formidable challenge to science and engineering educators and researchers. At scales where intuitive reasoning or conceptualized descriptions of material systems may not suffice, IN-VSEE offers a unique, visualization-based educational approach that enhances student learning by remote operation of research grade scanning probe instruments that are ideally suited to study material structure and properties at micro- and nanometer scales¹. This initiative may be particularly relevant to bioengineering educational programs that aspire to prepare bioengineers for successful careers in emerging nanobiotechnology envisioned to evolve in the 21st Century.

II. METHODS

The IN-VSEE² initiative is currently developing distance learning resources available on the WWW (<http://invsee.asu.edu>) that provides educators the ability to study real material systems at nanoscale dimensions. The resources to date are:

- Web-based remote scanning probe instrumentation that allows discovery-based learning and exploration at the nanoscale
- A series of WWW interactive educational modules that represent diverse material systems
- A web-accessible image gallery to complement visual-based learning

III. RESULTS

IN-VSEE has created a unique, Web-accessible computer interface³ with state-of-the-art Scanning Probe Microscopes (SPM) that can transform any classroom having appropriate internet connection into a discovery-based, virtual learning laboratory. INVSEE pilot studies have demonstrated that

students can learn to design and perform scanning probe experiments remotely on diverse material systems at the micro- and nanoscale early on in their education. INVSEE also provides a series of educational modules to help remote users to understand both (a) the principles and operation of SPM using a virtual SPM simulator, and (b) the relationship of structure, properties, processing and performance of selected material systems at various scales. Additionally, an image gallery is now available whereby users can 'see' both structure and selected properties of real material systems at the micro- and nanoscale, as well as, directly make measurements on line.

IV. DISCUSSION

By the summer of 2000, fully assessed prototypical educational modules for representative material systems will be available on the WWW. We invite the science and engineering communities to partner with IN-VSEE in adopting and adapting existing modules, as well as, developing new modules and remote SPM experiments germane to their disciplines, such as biomaterials science and engineering and related bioengineering sub-disciplines.

V. CONCLUSIONS

For the first time, the delivery of asynchronous distance education and training using web-based advanced instrumentation has become a reality. It now may be possible to create seamless educational and research infrastructures to provide collaborative environments that foster new education and research paradigms to help prepare students for the emergent areas in nanobiotechnology.

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