



Integrating Environmentally Improved Photolithography Technology and Virtual Reality Games Into Advanced Nanotechnology Education



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Purpose

This project institutes an introductory nanotechnology course at Utah Valley University (UVU) that is intended as a first step to a curriculum of courses that will provide the missing link between current associate degree programs at UVU, and job requirements in local industries that utilize nano/micro-fabrication.

A novel aspect of this project is the creation and development of virtual reality (VR) modules to aid in the training of students on complex laboratory equipment and procedures. VR modules are created in the UVU Digital Media and Computer Science departments, in coordination with faculty in the physics and engineering departments, where laboratories using the real equipment are carried out.

Motivation

Equipment for nanotechnology fabrication and characterization is often expensive, complex, and of limited availability for educational use. Pretraining with VR simulations makes students feel more comfortable using the real equipment, less likely to make mistakes that could damage equipment, and more safe in the lab. The modules reproduce the real equipment with high fidelity. Students are required to complete a full set of steps using the equipment, following the same procedures as in the laboratory, and must complete these simulations with a minimum score (optionally) within a specified time limit. Times to complete the real laboratories are reduced, less errors are made, and students gain a deeper understanding of equipment and processes.

Resources

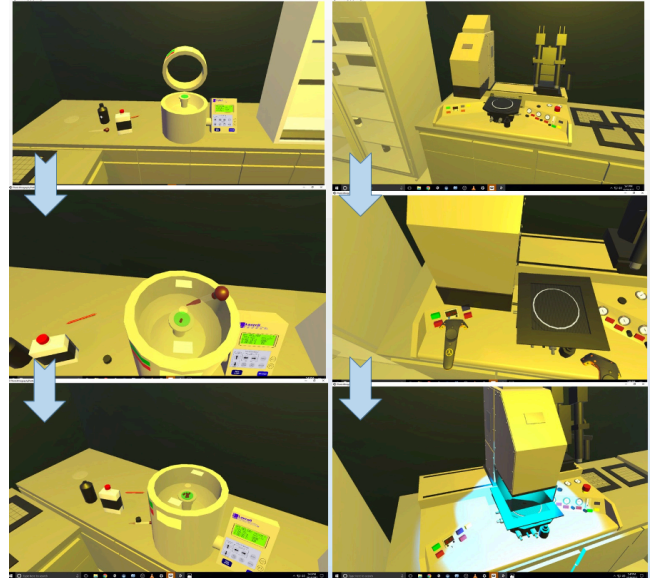
Project website: uvu.edu/physics/nanotech

Contacts: Paul.Weber@uvu.edu (PI) Laboratory structure
Marty.Clayton@uvu.edu VR simulation creation

References

- [1] R. Kamali-Sarvestani, P. Weber, M. Clayton, M. Meyers and S. Slade, "Virtual Reality to Improve Nanotechnology Education," IEEE Nanotechnology Magazine Vol. 4. Iss. 4, Aug. 2020.
- [2] R. Kamali-Sarvestani, P. Weber, and A. Minaie, NSF-ATE Proposal 1700695.

Virtual Reality Views of Wafer Fabrication Equipment



Course Experiences

Most VR modules required 20 minutes to complete, once learned and practiced by students. **There was no problem to entice students to go do their VR training!** Laboratories took about 1.5 hours to complete, and those with VR pre-training were carried out more confidently and elicited more and deeper questions about the process, than if students had not done pre-training. Four laboratory simulations were used in the first course, two more will be built and included in the next offering in Spring 2021.

"I felt a lot more confident with running the real machine after the VR lab. I know it increased my speed and helped me understand the process."

"I would not have felt comfortable with such expensive equipment if I had not had a risk-free trial. It improved my efficiency and effectiveness, and my understanding of how the lab worked."

Conclusion

This project has increased educational resources for nanotechnology education at UVU, and has created VR modules that are publicly available. Training in the processes and methods of virtual reality will be offered in a workshop at UVU in May, 2021, for which participant travel support is available.