NANOWIRE

RAIN's Quarterly Newsletter

Building College-University Partnerships for Nanotechnology Workforce Development

RAIN-drops

February is now here, but since this is our first NanoWire of 2017, well still say Happy New Year! There are so many exciting opportunities coming your way via the Remotely Accessible Instruments for Nanotechnology (RAIN) Network in the coming months; we cant wait to tell you about them.

We are delighted to share that the RAIN provider network continues to grow, offering more occasions for students (and teachers) from across the country to access the finest in nanoscale characterization technology from the comfort of their own classrooms. In this edition, you will learn more about one of our newest members, Forsyth Technical College in Winston-Salem, NC. As a brief introduction, in addition to offering a strong nanotechnology workforce program for many years, Forsyth Techs nanotechnology students took first place in the June 2016 NSF-sponsored Community College Innovation Challenge. Welcome to RAIN, Forsyth Tech!

RAIN partners are continually pushing forward, looking for new and innovative ways to encourage and augment materials needed by students and teachers to keep up with the expectations in a growing STEM-based world. Our colleagues, Dr. Jared Ashcroft and Dr. William Miller, from Pasadena City College and Sacramento City College, share information later in this newsletter on "science labs that can be used, in conjunction with remote access instruments, to expose K-12 classes (as well as some undergraduate classrooms) to modern experimentation that will help fulfill requirement of Next Generation Science Standards (NGSS)."

So, if you are looking for stimulating laboratories that will enhance the learning outcomes for your students, we will discuss the compelling experiments that have been created to inspire and increase student excitement and participation. Be sure to leverage your new materials by scheduling a RAIN provider to conduct a remote analysis, using our state-of-the art equipment. In addition to nano-synthesis labs, our library includes labs investigating rocks and plants, as well as analyzing the air that we all breathe. What better way to engage your students than to introduce them to the wonders of the nano-world?

On February 17, we are very excited to be hosting a webinar featuring the North American Network of Science Labs Online (NANSLO), where presenter Brenda Canine will discuss how students, thousands of miles away from a lab, can log into the Montana NANSLO laboratory and operate real equipment to collect real data. Information about the NANSLO consortium and details about the webinar and registration can be found later in this newsletter.

As a reminder, if you would like to learn more about using RAIN in your classrooms, visit nano4me.org/remoteaccess. We want to continuously improve the RAIN Network, so please engage with us. Be sure to visit and like us on Facebook at facebook.com/nanotechnology.rain, where you can find exciting news in the world of nano-characterization, and perhaps whats new in your nano-world.

New RAIN Partner: Forsyth Technical Community College

RAIN is pleased to welcome its newest partner, the Nanotechnology Program at Forsyth Technical Community College. Forsyth Techs program strives to involve students in experiential learning that is based on enhancement of fundamental concepts of Nanotechnology. Our primary efforts are to train students for employment in industry and academia, and for advanced educational opportunities. In addition to RAIN, Forsyth Tech actively partners with the Wake Forest Center for Nanotechnology in Winston-Salem and the Joint School of Nanoscience and Nano engineering in Greensboro.

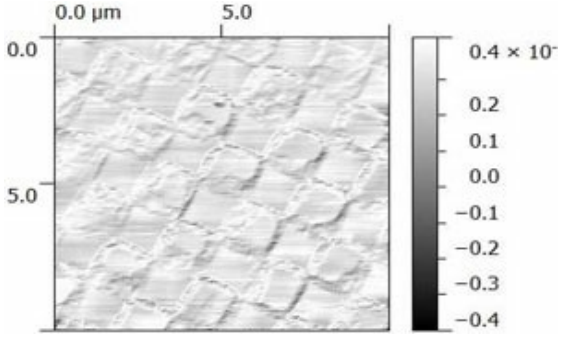


Image of silicon obtained with AFM.

Remotely Accessible Experiments for Use is K-12 Education

Jared Ashcroft and William Miller

Figure 1

Our education is experiencing a dramatic shift in content that students are exposed to in our K-12 system. Though the focus has been on common core, there is also a push to reevaluate how science courses are taught in the creation of Next Generation Science Standards (NGSS). A major shift is being observed where traditional teaching methods, such as: lectures, quizzes, exams, etc. are being replaced with new pedagogies. These new tools are based on problem or project based learning, such as inquiry based instruction, flipped classrooms, and peer guided learning. This pedagogical shift allows for innovative educators to pioneer the development and seek out new resources to implement in their courses. RAIN has been developing science labs that can be used in conjunction with remote access instruments to expose K-12 classes to modern experimentation that will help fulfill requirements of NGSS.

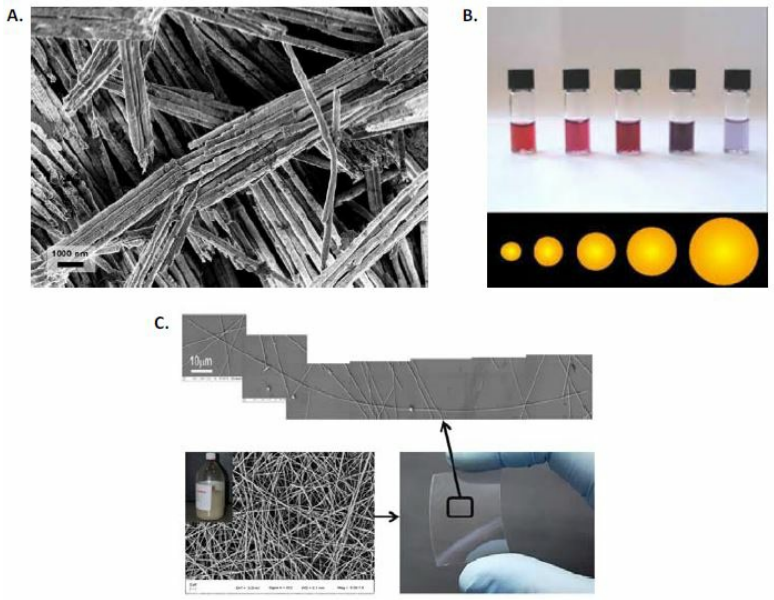


Figure 2: Nanoparticles Synthesized and Characterized in RAIN Experiment: A. Silver Nanowires, B. Gold Nanoparticles and C. Nickel Nanowires

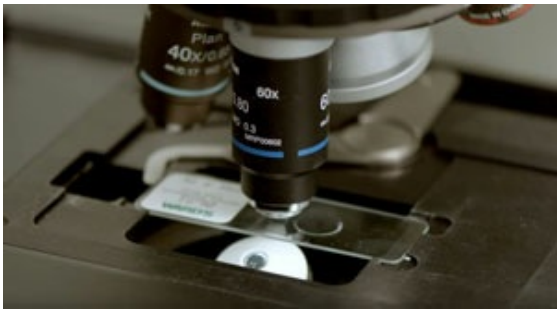
Currently, RAIN has access to seven experiments that can be used with remote access available on its website (www.nano4me.org/remoteaccess). These labs include basic chemistry labs that involve determining an unknown mineral using chemical and physical properties (See Figure 1) with elemental analysis using energy dispersive spectroscopy (EDS), studying the phytotoxicity of mung beans with various nanoparticle interactions shown in the image to the left that has mung beans grown in a silicon dioxide nanoparticle solution. These SiO_2 infused mung beans were then visualized using a scanning electron microscope (SEM) and finally a lab that quantifies the percent oxygen in a room using steel wool. In this experiment, the oxidation of steel wool in the process can be visualized using SEM and an empirical formula can be determined of the oxidized steel wool with EDS.

A second set of labs are focused on courses in nanotechnology, though they can be used in K-12 or undergraduate science curricula. These include a gold, silver, and nickel nanoparticle synthesis and characterization (See Figure 2). An advanced lab, based on fabrication of a Dye-Sensitized Nanocrystalline Solar Cell using titanium dioxide and raspberry juice, is available for students and faculty who want to imbed a challenging activity in their course.

RAIN is available to any educator, at any level, and we hope you will implement our experiments into your classroom and take advantage of our remotely accessible instruments at no cost to your educational institution.

Remote Web-Based Science Labs

For those of us in the RAIN network, we know that access to our sophisticated instrumentation can be a strong outreach tool to engage students in the science classrooms. We often wonder how other disciplines use web-based access to instrumentation.



Enter NANSLO, an international consortium enabling access to high-quality, modular, openly licensed courseware, integrating immersive web-based labs with software, video, and robotics for the study of science courses. http://www.wiche.edu/nanslo. To learn what facilitators, technicians, and faculty, who have used NANSLO, feel about the impact in the classroom, visit this link and let us know what you think, https://youtu.be/znvQhNl2vMY

Benefits of NANSLO for students:

- Gain access to sophisticated lab equipment remotely.
- Experience lab opportunities that may not be available locally or difficult to schedule based on personal and work commitments.
- Robotically control lab equipment through web-enabled software.
- Access accurate scientific data making the experience authentic for students.
- College data in real time.
- Opportunities to work as a group on experiments just as in a face-to-face setting.
- Ability to capture high quality pictures for assignments and reports.
- Expand opportunities to practice what has already been covered in class.
- Learn software skills that can be leveraged in class and in work.

After you have had a chance to review the YouTube video and check out the NANSLO website, we hope you will be interested in joining us on the Friday, February 17 webinar. There are so many exciting opportunities for students, in remote locations, to truly experience cutting edge technology from the comfort of their own classrooms (or livingrooms).

RAIN Partners Around the United States

Contact any member of the RAIN leadership team if you too would like to become a RAIN partner.

Upcoming Webinar

NANSLO Remote Web-Based Science Labs: Real Science in Real Time

We invite you to register for an exciting new webinar: **NANSLO Remote Web-Based Science Labs: Real Science in Real Time**, Friday, February 17, 2017 at 1pm ET. During this webinar our presenter, Brenda Canine, Lab Manager and Instructional Designer at Great Falls College Montana State University in Great Falls Montana, will share insights and information on how students, thousands of miles away, can use remote interactive science equipment, in real time to collect real data. The NANSLO laboratory features microscopes with automated robotic slide loaders, UV-VIS spectrometers, Gas Chromatographs and other specialized equipment which allow for explorations in Chemistry and Biology.

Read more about what the North American Network of Science Labs Online (NANSLO) at **www.wiche.edu/nanslo**. Please **click here** to register for this free event.

Let Us Know

We hope you enjoyed this edition of the RAIN newsletter. We look forward to sharing our news and updates this. We would really like to hear from you, if there is some subject or topic that you would like us to discuss or look into please let us know. Visit us on Facebook, https://www.facebook.com/nanotechnology.rain.

Regards,

The RAIN Leadership Team

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The NACK Network, in the Penn State College of Engineering, is committed to supporting the development of two-year degree programs in micro and nanotechnology across the country by offering academic and educational resources.

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