

ALBERTA BIO FUTURE PROGRAM HIGHLIGHTS

Bioimaging With Lignin-Based Carbon Quantum Dots

Health clinicians may soon have a new and effective bioimaging tool to produce in-depth personal medical reports based on a patient's genetics or to better diagnose presence of some diseases like hepatitis C and cancer.

"Carbon quantum dots (C-dots) derived from lignin can 'shine the light'," said Dr. Weizheng Shen, Research Associate, Applied Bio/Nano Industrial Research Chair program in NAIT. She has proven the concept that the high-value nanomaterial C-dots are more visible under the microscope than conventional materials. C-dots are bright, non-toxic, highly soluble and low-cost as compared to the commonly used semiconductor quantum dots.

Alberta Innovates funded the research under the Alberta Bio Future Lignin Challenge subprogram in project BFL-18-009. "We appreciate the financial support from Alberta Innovates in this early stage research," said Dr. Shen. "They took a chance on this idea."



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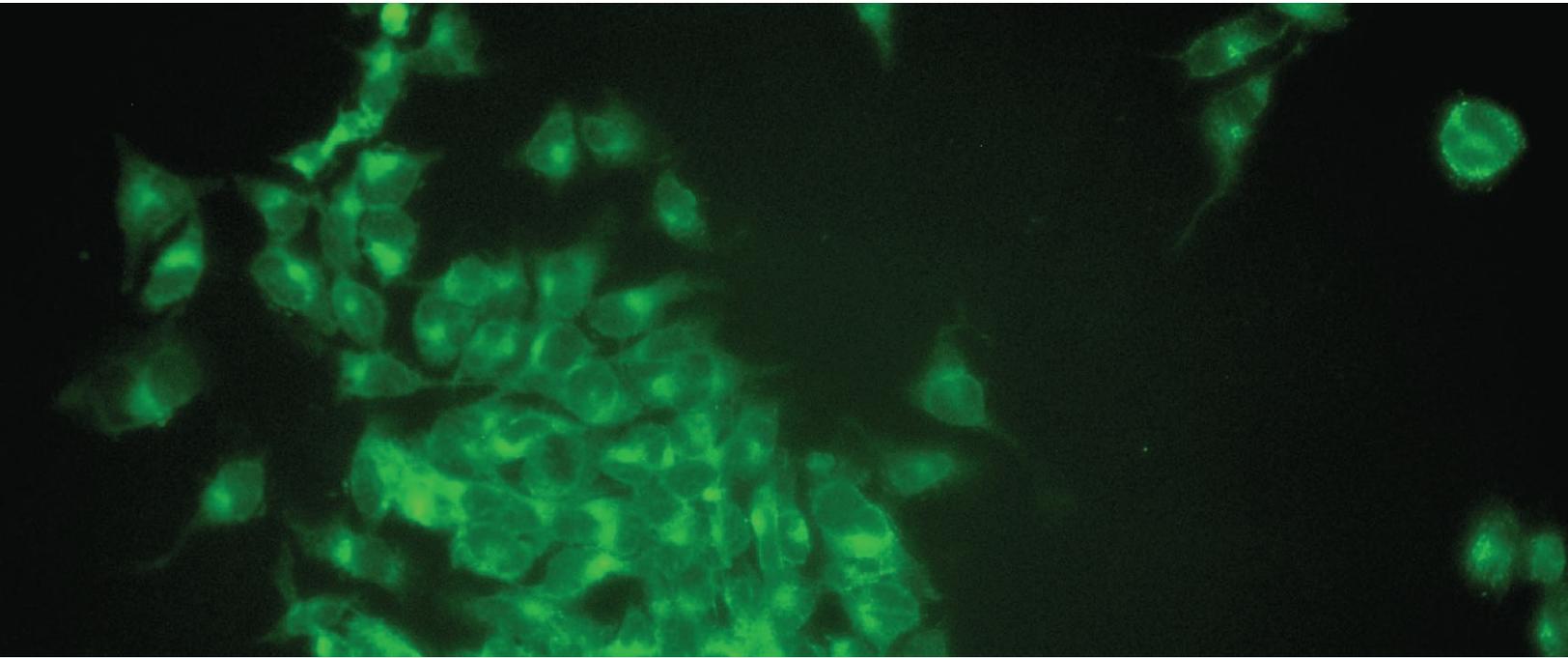
Dr. Weizheng Shen

Research Associate, Applied Bio/Nano Industrial Research Chair program, NAIT



The bioimaging slide is prepared and examined under a fluorescence microscope. It uses a tissue sample from a patient, then incubates it with C-dots from lignin (see photo). Lignin, a major component of trees, is plentiful in Alberta and has been underused for a very long time. The project's industry partner, West Fraser Hinton Mills, built and commissioned the first lignin recovery plant in Canada. They consistently produce high-quality and pure lignin, guaranteeing the excellent performance of the C-dots product.

Quantum dots in the past contained a very toxic chemical, cadmium, that led to serious health and environmental concerns. Research to create alternative quantum dots from carbon has been underway for a decade but no products have successfully entered the market because of difficulties scaling from the lab to commercial production. Now that Dr. Shen has a scalable process to develop C-dots from lignin, she will work with potential collaborators to move this lab product into the market. For example, the C-dots can be functionalized with DNA sequence to detect the early stages of the highly infectious disease, hepatitis C. C-dots can also be combined with DNA sequencing to generate a personal medical report. One of Dr. Shen's collaborators has a DNA sequencing facility and strong connections with international leaders in big data, genomics and personal medicine.



Carbon quantum dots from lignin, shown in photo as seen under a fluorescence microscope, hold immense potential to boost advances in personal medicine, disease diagnostics and even soil remediation.

Source: Dr. Weizheng Shen

The unique properties of C-dots, especially its high solubility, large surface area, non-toxicity and fluorescence are of interest to the soil remediation team at NAIT. Dr. Shen and the team have applied for funding to research if lignin-based C-dots can be used as a soil amendment to encourage the degradation of hydrocarbon contaminants at oil and gas sites.

While health bioimaging and soil remediation don't seem connected, the use of carbon quantum dots for these two applications is well-aligned based on the chemistry of carbon. Dr. Shen says, "Alberta is not just about oil and gas. We also have huge forest renewable resources as a source of the lignin in new technology - carbon quantum dots - that can help with soil remediation in our oil and gas sector."

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