High school team files patent application for new highly effective, eco-friendly flame retardant

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Davis (l), Kim, Guo and Rafailovich in the Rafailovich Lab (2015).

Fire consumes wood ferociously, in a deadly blaze—but the substances used to treat wood to resist burning can also be noxious and toxic. A Stony Brook University Materials Science Professor guided an undergraduate and two Long Island high school students as they developed a patent-pending, environmentally sustainable way to render the wood used in construction flame retardant—and 5x stronger—using natural materials.

"Our Office of Technology Transfer and Industry Relations has already gotten interest from several companies regarding possible license," says

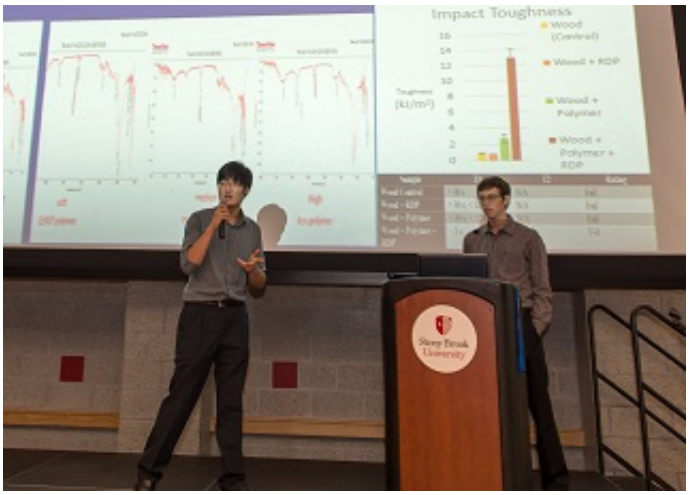
Miriam Rafailovich, who oversaw the research. Rafailovich is Distinguished Professor in the Department of Materials Science and Co-Director of the Program in Chemical and Molecular Engineering at Stony Brook University.

The work took place at the Garcia Center for Polymers at Engineered Interfaces at Stony Brook as part of the Garcia Research Scholar Program. The pre-college program offers the opportunity for high school students and teachers to perform research at the forefront of polymer science and technology alongside Garcia Center faculty and staff.

"The students were the primary drivers in this work; I guided them in addressing the pertinent questions," Rafailovich says.

The research was initiated by Tehila Stone, a former student in the Garcia program. Stone worked as an undergraduate mentor at Stony Brook this past summer with the high school students, Daniel Kim and Noah Davis.

Davis, a senior at Earl L. Vandermuelen High School on Long Island, says he has always been interested in math and the sciences. "This led me to look for research programs over the summer. I learned about the Garcia Program, and the focus on polymer-based engineering immediately drew my interest." Kim, a senior at Smithtown High School West—also on Long Island—says "the Garcia Program was the optimal choice for access to a quality lab and great mentorship."



Kim (l) and Davis present their research at the Garcia Summer Research Program meeting in August 2014.

The team started off with a simple 2x4 from Lowe's; the flame retardant is a phosphor-based material safe for the environment. The researchers engineered a compound that impregnates wood's natural structure, forming a wood-plastic composite that exceeds UL 94 V-O criteria for safety of flammability. "The breakthrough was in the formulation of a compound that extinguishes a flame without decomposing into toxic byproducts," Rafailovich says.

That's ideal for the construction industry. Says Kim, "What interested me the most was that it could be used to safeguard homes and buildings. The idea that the world can really benefit from flame retardant wood was my greatest motivation for this project."

The interdisciplinary effort involved Dr. Marcia Simon, Professor and Director for Graduate Studies in the Department of Oral Biology and Pathology at the Stony Brook University School of Dental Medicine. Simon is also Director of the Living Skin Bank, and helped design the toxicology testing and evaluate EPA reports.

"The students chose to use resorcinol bis(diphenyl phosphate) (RDP), which the EPA has declared a preferred substitute for halogenated flame retardants," Simon says. "Preliminary data in our laboratory confirms that when RDP is reacted with cellulose, or clays, such as was done by the students, it is safe and non-cytoxic. Although the finished product is safe, in vitro tests suggest that the unreacted RDP liquid, used in industrial plants, can be cytotoxic and should be handled with care."

Rafailovich is pleased the young learners had this opportunity. "I believe that a great deal of innovation is possible if we encourage students to explore their ideas," she says. "Students are more in-tune than older adults with the latest science developments in the consumer arena, but don't have the tools and knowledge to act on these ideas. We hope that by helping them do that, they will learn the power of science and be inspired to remain in the field."

Davis certainly feels that way. "Dan and I worked with different chemicals and beakers to measure out volumes; we used heating ovens to create reactions between the wood and chemicals; after the wood samples were created, we tested their properties with the UL-94 flame test and an Izod impact test. While I already had a large interest in science before the program, the experience only furthered that interest. I currently want to study biomedical engineering, and see this as a direct result of my experiences within the program."

Says Rafailovich, "Stony Brook is a unique place where all this is possible. New science is problem-focused, and requires interdisciplinary collaborations across all areas of the campus. With its medical, dental, and engineering facilities, and proximity to Brookhaven National Laboratory and outstanding industrial parks, Stony Brook is ideal for this type of research."

It's also a good place for translating research into applications. "Our

Office of Technology Transfer and Industry Relations is exceptional," Rafailovich says. "It requires a special staff to keep up with the diversity of science and industry, and over the years Stony Brook has established this network. A technology transfer staff that teaches and involves student is even more rare, making the Stony Brook years very memorable for any student who is fortunate to experience this."

Provided by Stony Brook University