A new silicon valley in the Northeast?

U.S. Army

WATERVLIET ARSENAL, N.Y. (Aug. 29, 2012) -- Not since the gold rush days of 1848 in California or Spindletop's striking of black gold in Texas in 1901, has there been a natural resource find that may be as significant -- until now.

In just a few research labs in the Northeast, are a handful of scientists with Ph.Ds and graduate students who are working hard to bring this new resource into the homes of every American, and the Army is right in the middle of this discovery.

The Army's Benét Laboratories, which is located at the Watervliet Arsenal in upstate New York, brought together nearly 30 of the nation's experts this month to share information about a little known resource called "black silicon."

This is not an easy field to understand, or even to report on, as the discussion went from lively debates about convergent-beam electron diffractions to pressure-induced phase transformations during femtosecond-laser surface texturing of silicon. Nevertheless, those who attended not only understood this subject matter, they also had an uncanny enthusiasm about something the human eye cannot see, nor can the average person understand.

Just as visible light comes in many different colors, infrared light also has a broad spectrum of "colors," said Jeffrey Warrender, who has a Ph.D in Applied Physics and is Benét's leading black silicon researcher. But most light passes right through ordinary silicon imagers without being absorbed.

The black silicon community's goal is to devise techniques to modify silicon's properties so that it can absorb more of these infrared colors while still taking advantage of the manufacturing infrastructure that produces inexpensive silicon-based imagers and devices such as camera phones, Warrender said.

The Army's involvement, via Benét Labs, is to leverage this new technology to improve situational awareness for U.S. troops on the battlefield.

"Although there are numerous applications for black silicon technology that could affect and improve our daily lives, our prime interest at Benét is to give the Soldier an improved weapon scope, enhanced night vision goggles, better infrared-based targeting, and enhanced explosive detection," Warrender said.

The presenters for this symposium came from such academic institutions as Harvard, MIT, and RPI. They provided the theory, but theory is only so good unless there is some sort of application. This is where Martin Pralle comes in.

Pralle, who has a Ph.D in materials science and is the vice president of Business Development for a Massachusetts company called SiOnyx, Inc., said that black

silicon has a wide range of potential uses from commercial to industrial to medical to defense.

"My company takes the theory, such as was discussed in Benét's symposium, and turns it into devices," Pralle said.

Pralle further explained that some of the products SiOnyx is working on will not only improve consumer-oriented products such as home security systems, but also could become the next generation of defense imagery devices that will dramatically improve daytime and nighttime surveillance and targeting.

"The value of black silicon cannot be understated," Pralle said. "From a common resource called silicon, we can apply a laser to it to give it properties that will greatly improve performance of imagery devices and do so with a much lower price point."

In a previous Benét Black Silicon Symposium, Harvard Professor Eric Mazur said the discovery of black silicon at his university was by accident in the late 1990s.

"We (Harvard) were doing research on platinum surfaces for the Army Research Laboratories and we knew that after three years of research we had to do something different or the Army funding would dry up," Mazur said.

From a dusty little bottle of sulfur hexafluoride that was laying around - a gas used by the semiconductor industry - they decided to toy with the sulfur gas using a laser on a silicon surface, Mazur said. "What we found was that after the silicon wafer had been hit with a laser the wafer turned black."

Mazur said the absorption of visible light of typical silicon wafers is about 60 percent, and is effectively zero for most of the infrared spectrum. But when the sulfur is applied to the silicon wafer and then roughed up with a laser the wafer shows dramatic infrared absorption.

The value of Benét's Black Silicon Symposium this month also cannot be understated.

"What Benét did was to bring together academia with those who will turn theory into devices, each motivating each other to do more in the field of black silicon," Pralle said.

Benét Laboratories is a Department of the Army research, development and engineering facility located at the Watervliet Arsenal. It is a part of the Weapons & Software Engineering Center (WSEC), Armament Research, Development, and Engineering Center, which is located at Picatinny Arsenal, N.J.

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