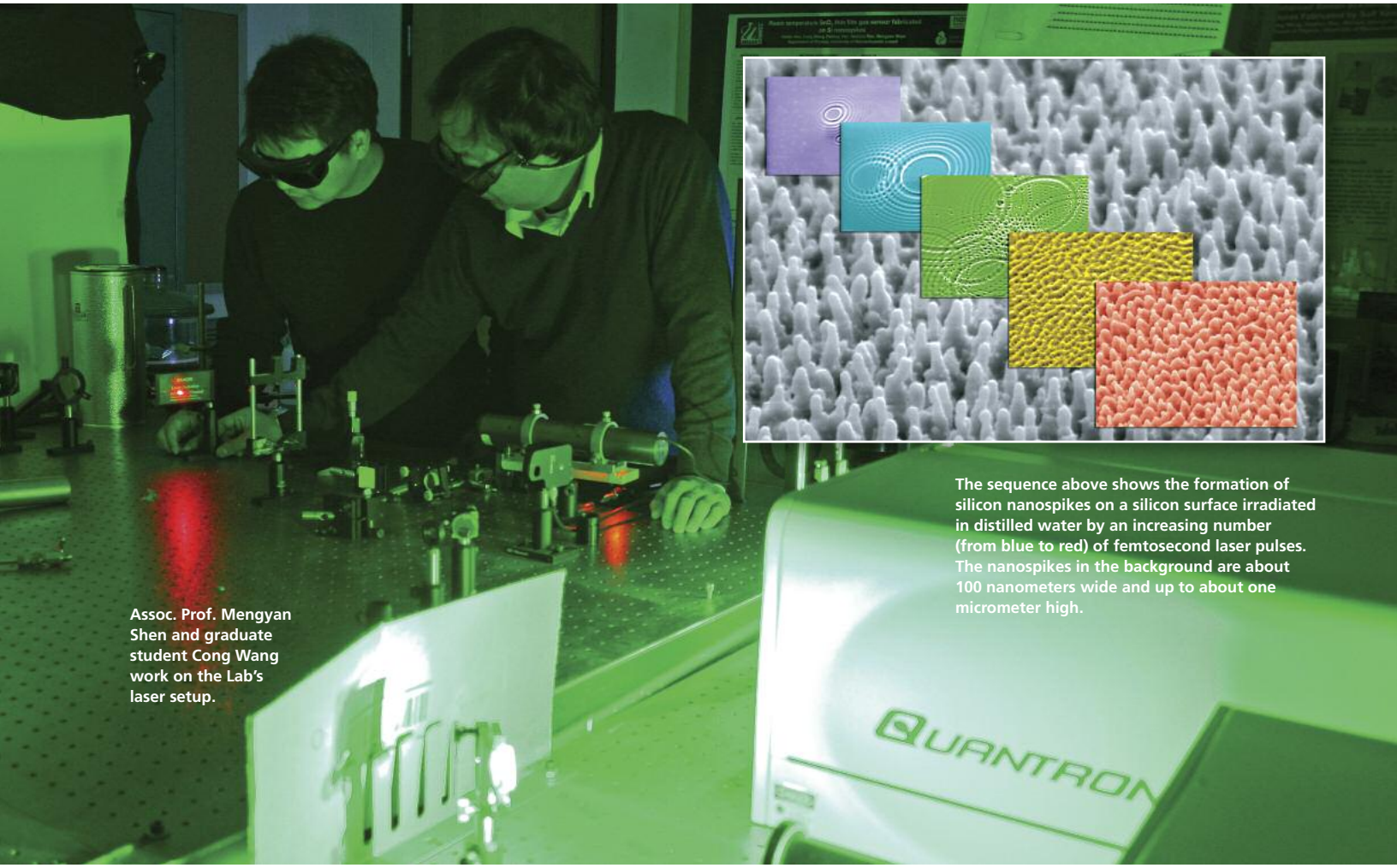
The Laboratory for Nanoscience and Laser Applications

Creating Nanostructures on Solid Surfaces Using Pulsed Laser



Assoc. Prof. Mengyan Shen and graduate student Cong Wang work on the Lab's laser setup.

The sequence above shows the formation of silicon nanospikes on a silicon surface irradiated in distilled water by an increasing number (from blue to red) of femtosecond laser pulses. The nanospikes in the background are about 100 nanometers wide and up to about one micrometer high.

"We are using intensive pulsed laser to study interactions between laser pulses and matter for potential applications in nanoscience and nanotechnology," says Assoc. Prof. Mengyan Shen, head of the Lab's Femtosecond Laser Group. The team utilizes femtosecond (10^{-13} sec.) pulsed laser at 400 and 800 nanometers (nm) to fabricate nanostructures on a solid surface.

"The technique is highly efficient because it is several orders faster than electron-beam writing and ion-beam etching, and is applicable to different materials," he says. "It has applications in opto-electronics such as high-efficiency photodetectors and solar cells, as well as in biology and medical research such as micro/nano tunnels for low-friction fluidity, and nanostructured metal surfaces for other applications."

The group has successfully developed soft nanolithography to three-dimensionally replicate silicon nanospike structures made by femtosecond laser pulse irradiation to a precision of 5 nm. The replicated nanostructures are being used to manufacture identical chemical and gas sensors at very low cost. This research has been supported by the National Science Foundation (NSF).

"With metal nanostructures formed with femtosecond laser irradiation, a natural-like photosynthesis has shown great potential for storing solar energy and saving our environment," says Shen. This research has been partially supported by seed fund from the NSF Center for High-Rate Nanomanufacturing at UMass Lowell.

He says the group is also developing techniques for time-resolved spectra measurements, in the time range from seconds to femtoseconds, for other applications in nanoscience and nanotechnology.

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