

Research Report

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Research Period	2025/7/17-2025/10/17
Research Field	Laser texturing, surface modification, antibacterial properties, laser-induced periodic surface structures (LIPSS)



Research Theme at Tokai University	
Title:	Texturing Solid Substrate Surface with Laser to Reduce Bacterial Adhesion and for High-Power Laser Development
Abstract:	The objective of this research was to design and fabricate nanodot structures on silicon solar cell surfaces with controlled and reproducible topographies, utilizing laser irradiation in aqueous media. These engineered surfaces will be systematically analyzed to assess their hydrophobic properties and to investigate the relationship between surface topography, bacterial adhesion, and proliferation. The study focused on surface architectures that can be efficiently produced on silicon substrates using pulsed laser techniques, aiming to identify configurations that optimize both functional performance and manufacturability.
Results / Achievements:	
Please write a summary of your research results / achievements. Also, please share your research papers/articles, books, poster presentations if there is any.	
During the first month of the research, a comprehensive literature review was conducted to inform the design of an experiment aimed at generating novel findings in the field. This review guided the selection of key experimental parameters, including the use of aqueous media, a laser wavelength of 266 nm, specific pulse widths (7 ns), and a range of laser fluence values. Based on these parameters, a series of preliminary experiments were carried out to determine the optimal conditions for achieving effective surface texturing on silicon substrates. In the second month of the research, we irradiated silicon surface with nanosecond pulsed laser using different fluence and analyzed the prepared samples with laser microscope (OLS4500, Olympus Co., Ltd.), a field-emission scanning electron microscope (JEOL Co., Ltd.). After analyzing the size and the pattern of the surface spots we determined the melting threshold fluence for the silicon surface. In the third month of the project, we irradiated silicon surfaces using laser fluence levels below the melting threshold to induce surface texturing. By systematically testing various fluence values, we successfully achieved the formation of surface nanodots, as confirmed through imaging with a field-emission scanning electron microscope (JEOL Co., Ltd.). Based on the established optimal irradiation conditions, two samples with dimensions 2.5 cm ×2.5 cm were subsequently prepared for further evaluation of their antibacterial properties.	