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Enhanced Hydrogen Electrolysis and Heat Transfer Using Micro/Nano Structured Surfaces

Abstract.

The investigators have discovered that femtosecond laser processing of metal electrodes can increase the current that can be carried in electrolysis of water cells by 23 times for stainless steel electrodes. The investigators now want to perform additional research on optimizing the femtosecond production of different type of surface structures that have been observed to form. In particular the investigators are collaborating with NREL and Teledyne Energy Systems to now investigate the type of electrodes used in large scale industrial electrolysis systems. Scientifically what has been observed is that the increase in current that can be carried depends on the increase in surface area and on the ability of the surface to release very small bubbles at high frequencies. This release of small bubbles then allows for fresh ions to reach the electrodes for additional electrolysis. The production of hydrogen is directly related to the current that can be produced and carried between the electrodes being used for electrolysis. In a second application, the femtosecond produced surface modifications can increase the heat transfer. In the proposed research, both the application of the surfaces for enhanced hydrogen production and enhanced heat transfer for energy applications will be investigated. Since both depend highly on the release of small bubbles, the investigators will simultaneously investigate both. .