CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
S1817

Project Title
Effects of Excess Heat Generated by UV Laser Irradiation on the Exposure Process of Photostructure Glass

Abstract

Objectives/Goals
Glass-Ceramics are a commonly used material, found in for example mugs and stove tops. A new machining method is the Direct-Write method: a stationary pulsed UV laser and a sample moving on the x, y and z axis. The UV laser induces the incorporated Ce3+ ions to eject photoelectrons that are then trapped in the glass. The next steps of the machining process uses said trapped electrons.A possible problem arises with the photon absorption generating heat, which may reverse the photoelectron ejection process

Methods/Materials
This project investigates the effect of manipulating the laser energy distribution, and thus the heat, on the material exposure (formation of trapped electrons) as measured by optical absorption spectroscopy. The energy distributions are a set of 10008 points on a spreadsheet that define the amplitude profile of the deposited energy and the total energy is held constant among the different distributions. A Cary5000 spectrophotometer was used to measure the absorption of the electron from 250-290 nm.

Results
Out of the seven amplitude distributions tested, two having the profile of Triangle and Columns showed signs of being more efficient than the current process used, Top Hat. Columns was more efficient than Triangle.

Conclusions/Discussion
I believe Columns was more efficient because the profile had five columns dictating when the pulsed laser is turned on punctuated by spaces that lets the sample cool, thus decreasing energy available for the reverse reaction. By knowing how to better use the laser to trap electrons, scientists can create complex structures more efficiency with less energy wasted from inducing the reverse reaction.

Summary Statement
To observe the effects of the UV laser's heat on the exposure process (Ce3+ reaction), different heating rates were tested; it was shown that heat does effect the reaction and two tested distributions were more efficient than the standard.

Help Received
Using lab equipment at The Aerospace Corporation; mentoring from Dr. Henry Helvajian