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Viztic Photoacoustic Phased Array Project Abstract

David Weld, an Assistant Professor of Physics at UCSB, has developed a nanostructured film that has been noted to have strong photoacoustic properties. When a flashing light is aimed at this film, the film emits sound that matches the frequency of the light's modulation.

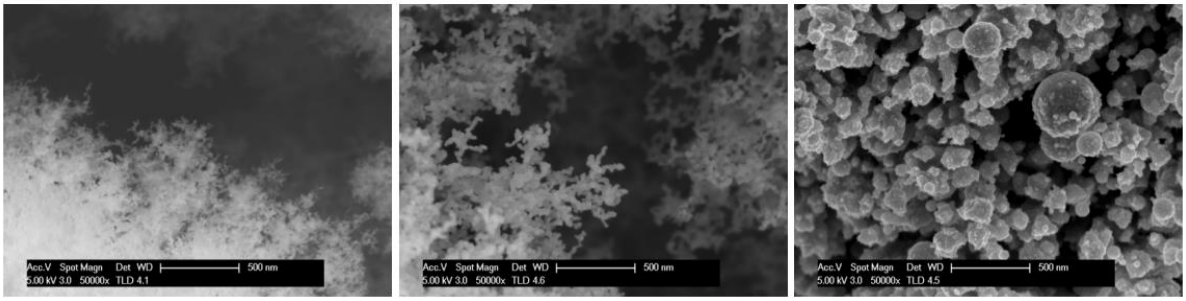

Figure 1. Microscopic views of the nonstructured film

The purpose of this project is to design and build an apparatus that will allow Weld and his research group to fully explore and characterize the nanostructured film. The apparatus will be a photoacoustic array implemented by high-powered LEDs. A photoacoustic array is a device that employs individual wave sources that each have their own phase. By varying the phases of each source, their waves can be made to either constructively or deconstructively interefere with each other. The result is an output wave that can be aimed or shaped by the user. Each LED will act as an individual source of light that will shine on a small region of the film so that the phase of each LED has its own unique effect on the film's emitted sound. Researchers will be able to adjust the phase of each LED in the matrix and observe the resulting photoacoustic responses of the film.

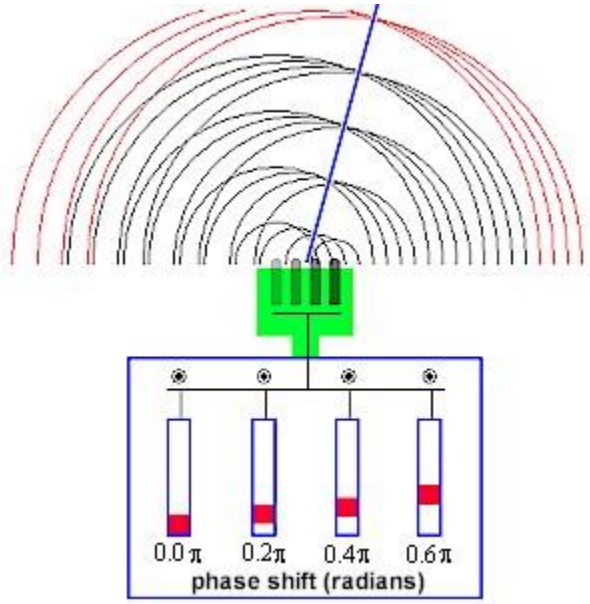

Figure 2. Basic operation of a phased array

Users will be able to program and control the array of LEDs with an FPGA according to their desired test variables. The FPGA will allow the output signals sent to each LED to be in the form pulse-width modulated (PWM) waves. With PWM outputs, not only can users adjust each LED's phase, but they may also adjust the duty-cycle (which governs the brightness) of each LED. Although the FPGA controls the switching of the LEDS, it will not be able to provide enough current to the high power LEDs required to generate an audible response from the film. In order to power the LEDs, special driver circuitry is required. Power MOSFETs will be used to provide high levels of current to the individual LEDs. The FPGA's output logic-high voltage (approximately 3.5V) is not high enough to provide sufficient gate-source voltages at the MOSFET to control switching. Gate drivers will be implemented to compensate for low current outputs.

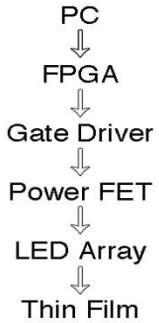

Figure 3. Block diagram of this project