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13. ABSTRACT *(Maximum 200 words)*

Arrays of microdischarge devices fabricated in Si have been improved in performance by utilizing VLSI fabrication technology and grading the dielectric. Also, a microdischarge device was fabricated in a multilayer ceramic structure in collaboration with colleagues at Motorola in Phoenix, AZ. Overall, this grant was crucial in supporting fundamental processing work to be carried out that has shown us how to proceed with constructing smaller devices.

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FINAL REPORT FOR AFOSR
GRANT NO. F49620-99-1-0317:

"EXPERIMENTAL STUDIES OF MICRODISCHARGE DEVICES AND ARRAYS"

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The funds provided by AFOSR under this grant have been used to significantly expand an ongoing research effort at the University of Illinois devoted to developing a new class of devices — microdischarges. Specifically, with this additional funding, we were able to hire another graduate student (and cover part of a postdoc's salary). This enabled us to carry out additional experiments on the microdischarges and the key results of this work were the following:

1. Arrays of microdischarge devices fabricated in Si have been improved in performance by utilizing state-of-the-art VLSI fabrication technology (e-beam masks, dry etchable polymers, etc.) and grading the dielectric. This processing work set the stage for recent dramatic advances in the size of microdischarge arrays (up to 30 × 30) and their electrical characteristics under our current AFOSR grant (F49620-00-1-0372). This portion of the experimental program has been conducted in collaboration with Prof. Chang Liu and his student, Jack Chen, of the Microelectronics Laboratory at the University of Illinois. Prior to this work, early pyramidal microdischarge device arrays were unreliable in ignition and operation.

2. Dr. S.-J. Park, the postdoc on the program, conducted a number of exploratory studies of small scale devices. He, for example, carried out preliminary experiments on a new type of discharge device that was briefly described on p. 9 of the renewal proposal submitted to AFOSR in June 2000. Briefly, mica granules having a mean diameter of 40 μm are suspended in the dielectric film of a three-layer microdischarge structure (and an anode screen) and the device is operated in the AC mode. We found that each mica crystallite gives rise to its own spatially-localized microdischarge. It appears that this technique can readily be extended to considerably smaller devices (< 5 μm) and this will be one focus of our efforts under the current AFOSR grant. Other techniques for producing small (< 30 μm) devices were demonstrated under this grant (such as using microchannels etched in Al and polystyrene spheres to guide RIE etching of microchannels) and will serve to undergird future work.

3. A microdischarge device was fabricated in a multilayer ceramic structure in collaboration with colleagues at Motorola in Phoenix, AZ. The ceramic technology adapted for this work is the same as that used to fabricate capacitors for wireless applications and the resulting device is quite robust.

In summary, the funding provided by AFOSR under this grant was crucial in that it supported fundamental processing work to be carried out that has shown us how to proceed with constructing smaller devices (with the goal of approaching the wave light of visible light) and larger arrays. We are most grateful for this AFOSR support and are convinced that it will continue to yield enormous dividends.