

# REPORT DOCUMENTATION PAGE

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## **Executive Summary**

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### **Three Dimensional Mold Making Capabilities**

In keeping with the primary thrust of this research effort, which is to develop novel methods for the fabrication of true three dimensional micro- and nano structures, an Atomic Force Microscope (AFM) and a small scale plating station were purchased. The AFM has been providing the capability for measurement and characterization of micro- and nano structures, as stemming from the grant research areas and projects. Moreover, the ability to electroplate a three-dimensionally varying geometry using multi-layer methods allows the realization of electroplated microstructures in an inexpensive and manufacturable fashion. The ultimate objective is to use both electro and electroless deposition techniques to fabricate molds and thereby demonstrate mass production of microstructures with an arbitrary geometric cross-section. In addition to mold fabrication, electrodeposited microstructures can be released from the substrate (using sacrificial layer technology) to yield unconstrained micro components that can be positioned in a micro assembly using post-processing techniques.

The new plating station offers significant advantages over the existing in-house fabricated stations. Real-time monitoring and precise control over critical parameters, which is necessary in order to achieve uniform deposition in high aspect ratio microstructures, is provided. The ability to electroplate in both acidic and alkaline solutions as well as certain solvent-based solutions is also an important attribute of this system. In addition to the more conventional direct current plating, enhancements include pulse current and pulse reverse current plating capabilities and a proprietary rotating disc electrode to ensure greater control of the deposition process making it possible to produce non-porous and uniform deposits over a 6" diameter substrate.

### **Human Resource Development**

Human resource development was originally envisioned to be mainly at the technician and undergraduate level, and developed principally by Grambling State University. Parts of the human resource development effort have been continued over the extension period of this grant.

A microtechnology curriculum was developed and initiated in the Manufacturing Engineering Technology program, under the direction of Dr. Edward Harrison. Students in the Manufacturing Engineering Technology program have taken the course in microtechnology, which has consisted of classroom education and hands-on laboratory training with a set of machinery that is ideally suited for an introduction to micromachining. Educational modules in the microtechnologies have been developed and recorded on tape. The topics included:

Overview of MEMS

Safety

Metrology

Vibration Isolation

Metrology and Testing

Precision Micromachining: a. Microdrilling, b. Micromilling, c. Laser Machining

Grambling has also been the focal point of the local outreach and the distance-learning network that includes Northwest Louisiana Technical College and Ruston Technical College. The human resources outreach also included local high schools.