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The Active Materials Laboratory has recently acquired upgraded and new equipmere made possible by the AFOSR in the form of a research grant as a part of the Defense University Research Instnnnentation Program. These purchases have aided the laboratory in achieving its goals of improving the current testing and analysis capabilities as well as contributing to the ability of creating a Remotely Observable Active Materials (ROAM) Laboratory. The ROAM Laboratory has been established to expand the knowledge base of active materials in general through cooperative learning and education fi.om applicable experiments.

A variety of equipment has been purchased by means of the DURIP research grant including: l) a Differential Scanning Calorimeter (DSC); 2) a tension/torsion test frame; 3) upgraded control and data acquisition capabilities of existing MTS servo-hydraulic tensile load frames; 4) widefield metallograph; 5) in-situ low force load apparatus for observation with the widefield metallograph; and 6) a quantitative metallographic anlysis system. A brief description of each of the equipment listed as well as its integration into the ROAM Lab will be given in the following section.

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Final Tech Report

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Final Deliverable on AFOSR Research Grant:

Active Materials Characterization Laboratory

Project No. 32525-58080

submitted by

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to the

Defense University Research Instrumentation Program

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Introduction

The Active Materials Laboratory has recently acquired upgraded and new equipment made possible by the AFOSR in the form of a research grant as a part of the Defense University Research Instrumentation Program. These purchases have aided the laboratory in achieving its goals of improving the current testing and analysis capabilities as well as contributing to the ability of creating a Remotely Observable Active Materials (ROAM) Laboratory. The ROAM Laboratory has been established to expand the knowledge base of active materials in general through cooperative learning and education from applicable experiments.

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Description of Research Instrumentation

Acquired Instrumentation and Application

Differential Scanning Calorimeter (DSC)

A Perkin –Elmer model Pyris 1-DSC with the Pyris series software for Windows NT 4.0 was purchased. The DSC has been used extensively in identifying various transformation temperatures for active materials and measuring the latent heat associated with the phase transformations. Thermal analysis has also been useful in analyzing active materials produced in the Active Materials Laboratory at Texas A&M.

Tension/Torsion Test Frame

A tension/torsion load frame was provided by Adelaide Testing Machines, Inc. The product is designed to user-specifications and consists of a screw-driven tension-compression/ torsion load frame with max loads of 20,000 lb. and 10,000 in-lb, respectively. The load frame has been used in preliminary tests of porous NiTi Shape Memory Alloy (SMA). New software is currently under way to improve the capability of the machine as well as incorporate the equipment with the ROAM Lab.

Upgrading Control And Data Acquisition Capabilities of Existing Servo-Hydraulic Tensile Load Frames

The current test control and data acquisition systems have been replaced by the MTS TestStar 2M digital control system along with the TestWorks and Labview integration testing software. The digital control software and interface have made testing and data acquisition with these hydraulic frames more feasible for less experienced students and

staff. Due to the ease of testing, use of these hydraulic systems has increased dramatically within the Aerospace Department and with outside departments.

Leica Widefield Metallograph

The system that was purchased is the Leica MEF 4M inveterted light microscope. The metallograph has been used with a variety of projects including active materials, composites, and conventional metals and alloys. Identification of grains, material defects, and cracks are easily identified by means of various filters and lenses which accompany the metallograph, including brightfield, darkfield, polarized light, polarization contrast and differential interference contrast filters and a spectrum of optical lenses ranging from 2.5x to 150x.

An In-Situ Low Force Load Apparatus

A low force load frame was designed and constructed by Rick Allen in the Texas A&M Aerospace Engineering Machine Shop. The frame is made from aluminum and high-tension steel for rigidity and is capable applying a force of over 500 lbs. It is compact and light enough to be mounted directly to the observation table of the metallograph for in-situ microanalysis of materials under load.

A Quantitative Metallographic Analysis System

A Leica DC200 digital (CCD) camera and capture software and Image-Pro analysis software were purchased for use with the metallograph. The digital images are analyzed quantitatively using the software and can be easily transferred to other research groups via the internet. Image-Pro provides a comprehensive set of imaging tools, such as particle counting, grain and phase analysis, volume fractions, calibrations which provide length-type measurements, and various other imaging tools.