MICROSCOPIST'S AIDE: A Computer Program Written to Analyze TEM Micrographs - D.E. Reinhart, (Graduate Research Assistant, University of Missouri, Rolla) and **D. S. Gelles, (Pacific Northwest National Laboratory)***

OBJECTIVE

Microstructural analysis procedures are being upgraded to a modern computer format.

SUMMARY

A computer program has been rewritten in DOS Basic allowing current state-of-the-art computer equipment to be used for quantitative measurement of microstructural features such as voids, dislocations and precipitates.

PROGRESS AND STATUS

Introduction

In the study of radiation damage in materials, transmission electron microscopes are used to observe the microstructure of the materials because they can attain spatial resolutions to the atomic scale. Photos of the microstructure, commonly referred to as micrographs, are taken and analyzed to determine such damage-related variables as dislocation density, void density, and void distribution.[1] By developing a computerized data acquisition system, researchers will be able to save valuable time and increase the accuracy of their calculations.

This program and its accompanying data acquisition system were created to replace a much older and much simpler program and system that had become obsolete. The specially designed void counting table and the stereoviewer were retained, and the new data acquisition system was specifically designed to incorporate these tools. The computer program can perform three functions: measuring foil thickness, calculating void/loop density and size distribution, and determining dislocation density.

The stereoviewer has been additionally equipped with an adjustable light source. The light is focused to a point and connected to a linear voltage displacement transducer (LVDT). This setup allows the user to focus the light to a point at the apparent upper and lower foil surfaces of the material in the micrographs. The program reads the change in voltage resulting from the movement of the LVDT across the foil and calculates a foil thickness, given the micrograph magnification.

The data obtained from the stereoviewer can then be used in determining the void and/or Frank loop density and size distribution from the same micrograph. This time, the micrograph is placed on the void counting table. A pneumatic piston has been mounted on the table. When the user activates the piston by pressing on the switch located under the table with his or her knee, it causes a small pin to puncture the micrograph and signals the computer to add to the count. If a particular direction is measured, such as <110>, sophisticated computational procedures can be used, such as those outlined in Reference 1. At the same time, a beam of light is focused by the operator to the same diameter as the void being counted. The wheel that adjusts the size of the light beam is connected to a voltage source and a variable resistor (rheostat). Any adjustment of the beam size will cause a subsequent change in the rheostat, and therefore the output voltage to the computer will vary. This voltage is converted by the program to the diameter of the beam, and the size of each void is recorded. The pin punctures in the micrograph allow the user to keep track of which voids or loops have been counted within the region of interest. Once the counting has been completed and the diameter of the region of interest on the foil has been entered into

the program, the computer can then calculate the void/loop density as well as the percent swelling of the material. Furthermore, once the user selects the desired size interval, the programs will create a histogram of the size distribution of the voids/loops.

The third primary function of the computer program, dislocation analysis, does not use an external tool to acquire data. Henceforth, all the data is entered by hand into the program. The basic procedure requires the user to place a transparent sheet over the top of the micrograph. This transparency has a square of specific length (usually 7 cm) drawn upon it, and the user strikes a key on the keyboard for every intersection of this square with a dislocation in the micrograph. After all intersections have been counted and an invisibility factor has been entered for the specific crystal orientation depicted in the print, the program calculates the dislocation density of that area of the material.

The entire computer program was written using National Instruments LabWindows BASIC version 2.2.1. Although LabWindows and the compiled stand-alone Microscopist's Aide executable file are both DOS based programs, the programs themselves are menu and mouse driven, providing a user-friendly environment. Data acquisition is made using a National Instruments Lab+ I/O board and 50 pin connector block.

A copy of the basic program is available on request.

FUTURE WORK

This effort is completed.

REFERENCE

1. D. S. Gelles, R. M. Claudson, and L. E. Thomas, DOE/ER-0313/3, 131.