Title
HIGH VOLTAGE ELECTRON MICROSCOPY AT BERKELEY

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A Hitachi 650kV electron microscope was installed at Berkeley in May 1969. (fig. 1) The fourier resolution test showed 4A° (fig. 2). The research program is centered around three principal advantages which open up new areas of microscopic analyses. These advantages are: a) the gain in transmission power with increasing voltage enabling thick specimens to be examined (up to about 6μ at 650kV depending on material) b) increased stability of roganic solids to radiation damage c) the disappearance voltage effect and fundamental advantages arising from many beam contrast phenomena at high energies.

The increase in transmission enables materials to be examined for which preparation of thin foils is difficult. It also enables specimens to be examined in some cases without any preparation. In the study of fossils it is particularly important to minimize preparation methods since material which has been imbedded in rocks for millions of years are usually brittle and difficult to section. Fig. 3 shows an example of the fibious structure of part of a graptolite specimen(1), which is 4×10^8 years old. Another example is a study of damage in as-received lunar surface particles (2) (fig. 4).

In ceramics research, we are studying the substructure and magnetic behavior of cobalt ferrites (3). Several interesting results have been obtained e.g. (1) the dislocations are not dissociated, but have a large Burgers vector ~6A° as deduced from comparing experimental and calculated dislocation image profiles(4), (2) Non-characteristic defects are produced as a result of radiation damage in the microscope, e.g. fig. 5. The defects are vacancy type and occur near the top surface of the foil. (3) Ferrimagnetic domains are resolved (fig. 6). The thickness fringes show that this material gives good resoltuion at thicknesses up to 1μ.

Radiation damage is also being investigated in biological materials (5). Preliminary results indicate that the primary cause of damage is due to bond rupture and that specimen heating is not a primary cause except at relatively high electron intensities. Other biological studies include chromosomes and phages. Cooperative studies with the State Department of Public Health have involved studying air pollution samples on organic membranes which are too thick for 100 kV. Asbestos fibres 1μ thick of tremolite were identified by electron diffraction (fig. 7a,b). These phases consist of many small polycrystals. Dr. W. L. Bell is working on many beam contrast effects with particular applications of the disappearance voltage phenomenon (6). Computer programs have been developed for a wide variet of cases. Other research activities include superconducting thin films, direct studies of phase transitions in alloys, defects in semiconductors, slip band growth in copper, radiation damage and other metallurgical programs.

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1. W. L. Bell and G. Thomas, Submitted to Science.
2. W. B. Berry, Takaji, G. Thomas and D. J. Jurica, These Proceedings.
3. L. De Jonghe, Ph. D. thesis in progress.
4. L. De Jonghe and W. L. Bell, Electron Microscopy 1970, Grenoble, France.
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6. W. L. Bell, Ibid., also HVEM conferences Pittsburgh 1969, Harwell 1970.

Fig. 1 The 650kV electron microscope at Berkeley.

Fig. 2 Showing lattice planes of 6A° and 4A° spacing in K_2PtCl_4.

Fig. 3 Fibres in orthograptus fossil.

Fig. 4 Radiation damage in Apollo 11 Lunar surface particles (unthinned).

Fig. 5 Radiation induced defects around conical etch pit (cobalt ferrite).

Fig. 6. Ferrimagnetic domains in cobalt ferrite.

Fig. 7 (a) Dark field image of tremolite asbestos in air pollution sample.
(b) Diffraction pattern from (a).

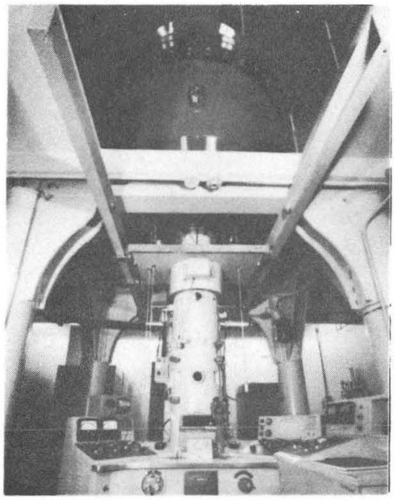


Fig. 1

Fig. 2

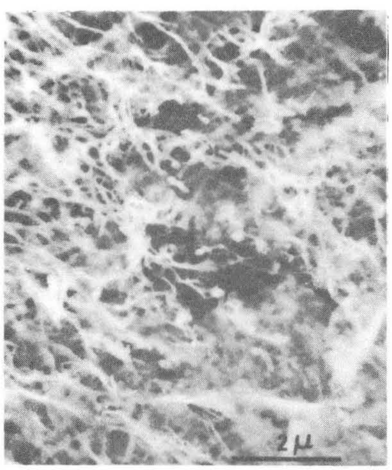


Fig. 3

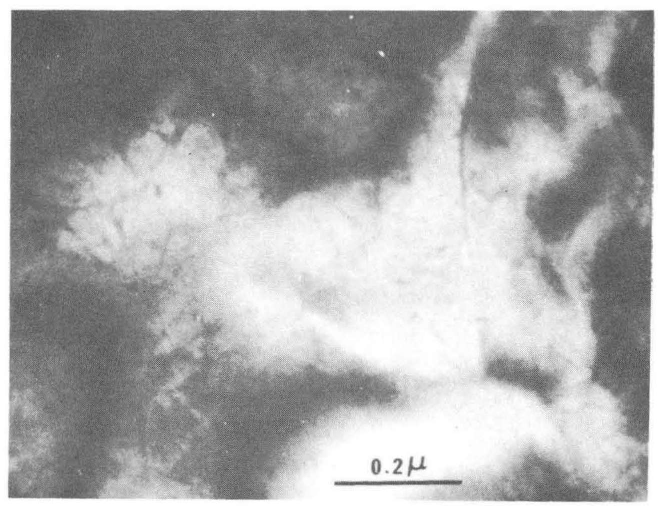


Fig. 4

XBB 705-2299
composite

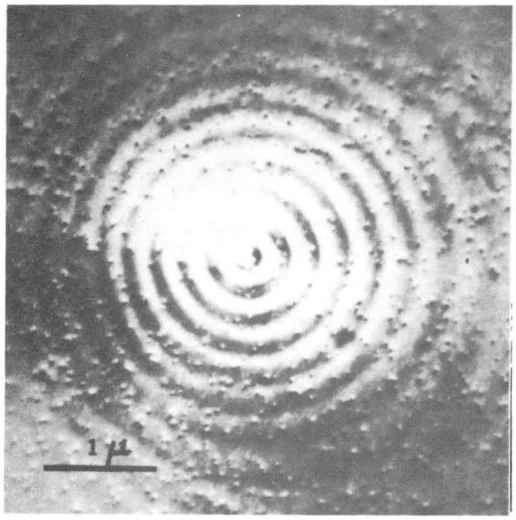


Fig. 5

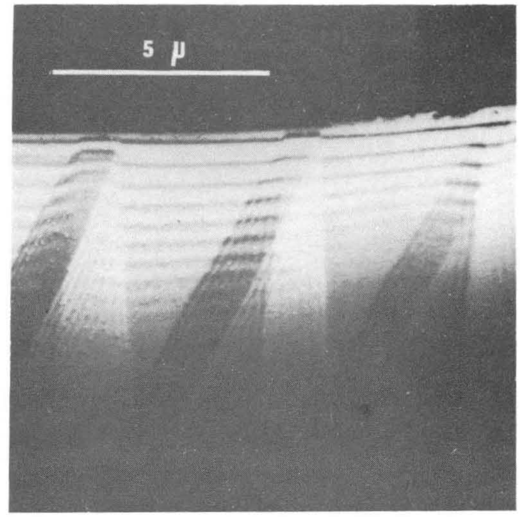
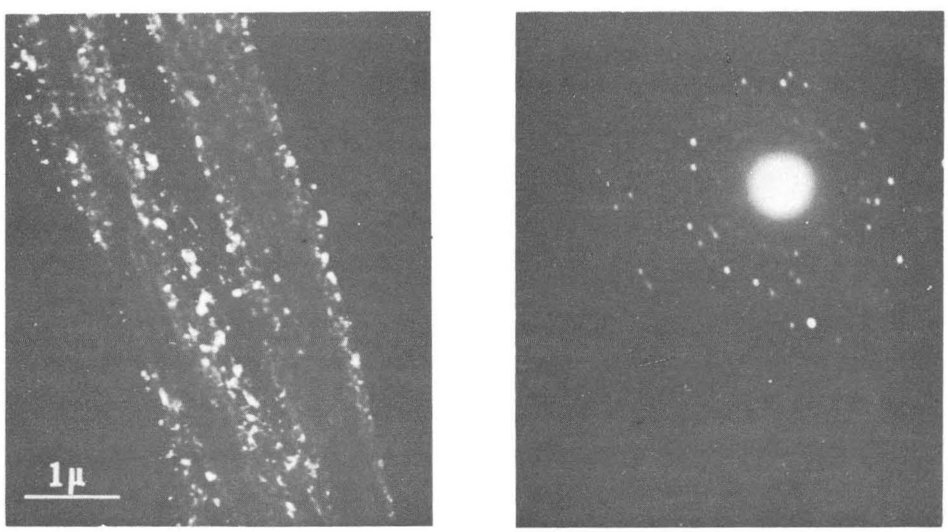


Fig. 6



(a) (b)

Fig. 7

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