Title
LATTICE IMAGE STUDIES OF ORDERED ALLOYS

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LATTICE IMAGE STUDIES OF ORDERED ALLOYS

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Lattice imaging is becoming a viable technique for investigating the structure, defects and early stages of phase transformations in ceramics (1,2) and metals (3-5). Our interest lies in its application to the study of ordering in alloys. Conventional images yield little information on the local degree of order in the specimen, the image width of defects may be as great as 50Å, and the interpretation of diffaction patterns and superlattice dark field micrographs is sometimes ambiguous (6,7). The advantage of the lattice image is its ability to provide data about atomic environment (from the nature of the lattice fringe profile) and to reveal atomic arrangements near defects. As electron microscopes become available possessing superior point-to-point resolution (better than 2Å) interpretation at each lattice point in the alloy will be possible, in an analogous manner to that obtained in oxide structures with larger lattice spacings (2). Our approach has involved several types of experiment (4,5).

1. Establishing, by computer simulation, the optimum experimental conditions for obtaining representative fringe profiles of ordered and disordered material. The agreement between theoretical and experimental images has also been good (4,5) (eg Fig. 1).
2. Study of atomic arrangements near ordered lattice defects. Metallurgical information has been derived concerning the fit of atomic planes at rotation domain boundaries in Mg_3Cd, CuAu and Au_4Cr and the nature of conservative and non-conservative translation antiphase boundaries in Cu_3Au, CuAu, Mg_3Cd, Au_4Cr and Ni_4Mo. The superiority of the lattice image over the conventional dark field is illustrated in Fig. 2.
3. Observing the change of nature of the fringes during the phase transformation. Variations in local degree of order in the specimen may be obtained from the image and this has been useful in establishing the reaction mechanism.
4. Identification of the fringe periodicities in alloys, quenched from above the critical ordering temperature. The short-range order (SRO) which exists is difficult both to study and interpret by conventional methods (6,7) but has now been unambiguously characterized in Cu_3Au and Au_4Cr by lattice imaging.

The success of lattice imaging for studying ordering has been demonstrated by this work in a range of alloy systems. We are continuing to apply the technique in this way and extending it to studies of the early stages of other phase transformation processes [e.g. spinodal decomposition (8)].

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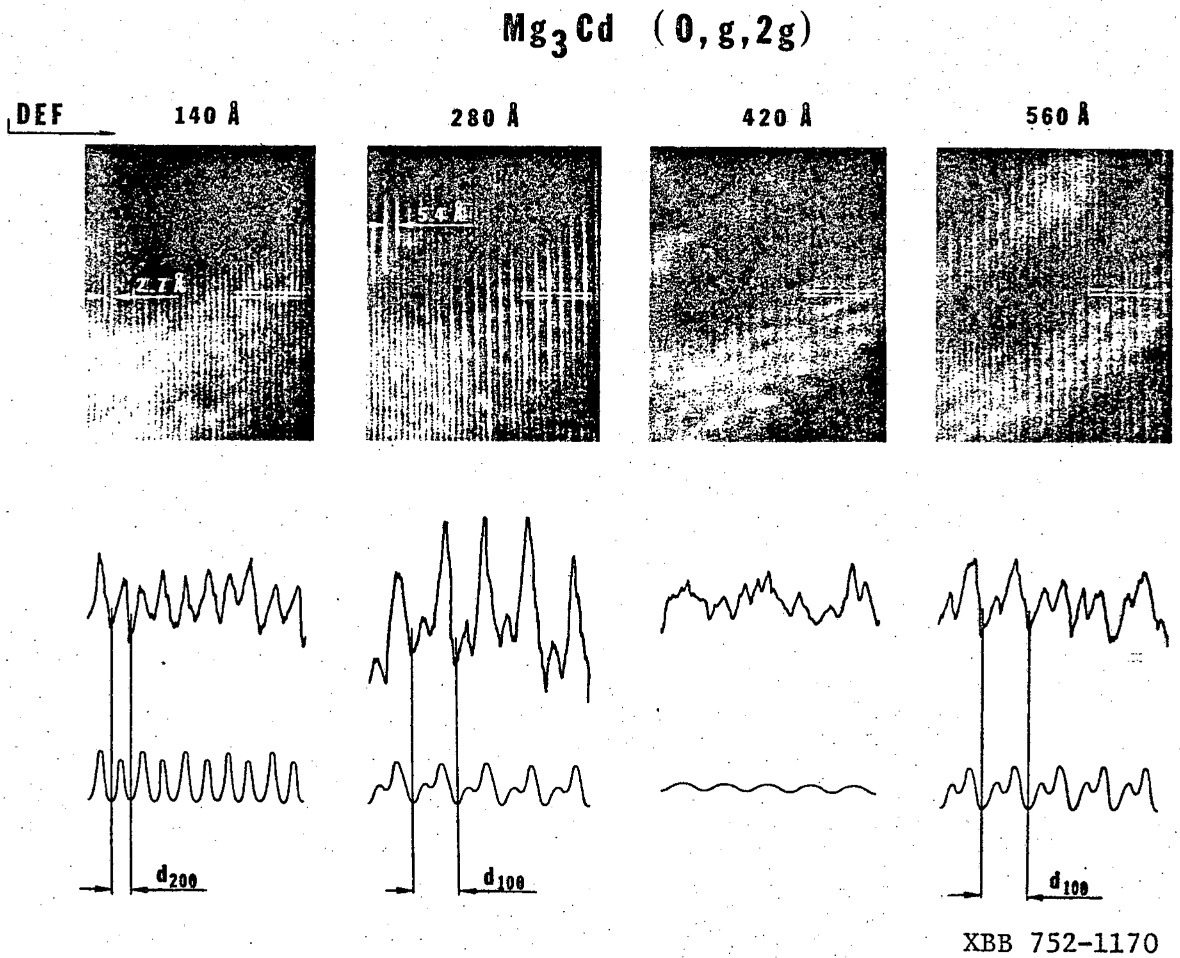
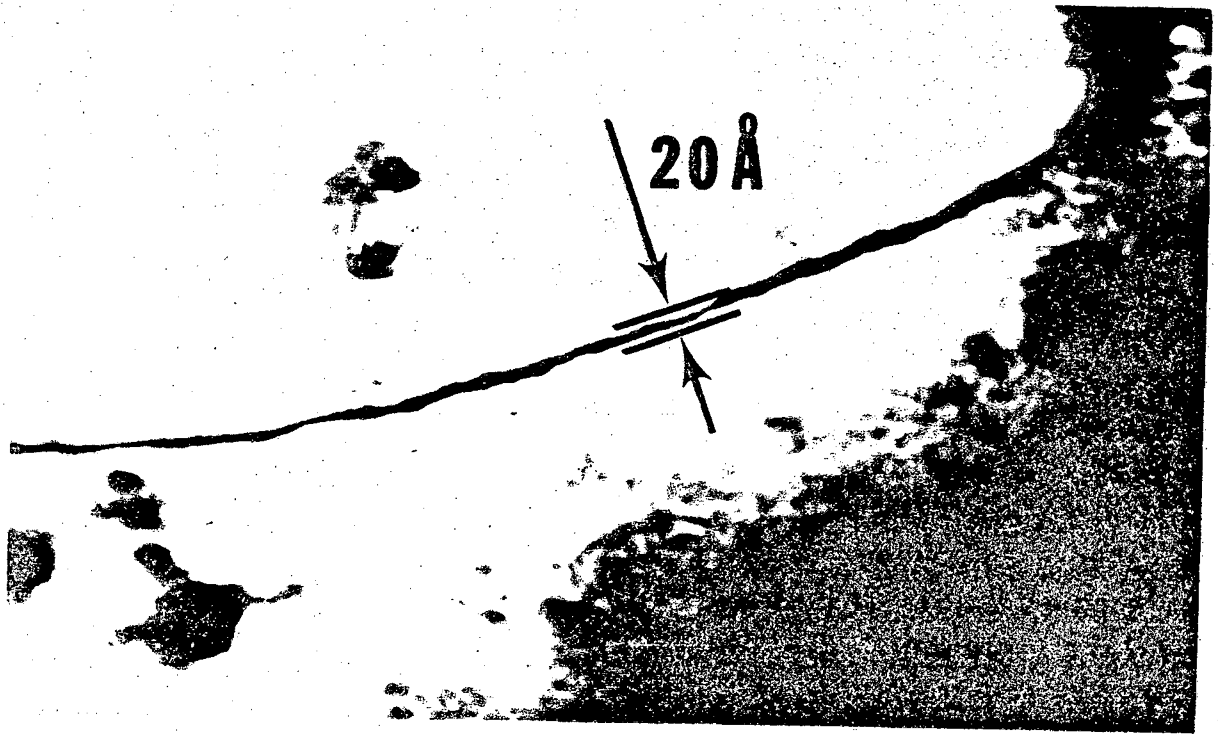


Fig. 1. Comparison of computed and Experimental Fringe profiles for Mg_3Cd.



a

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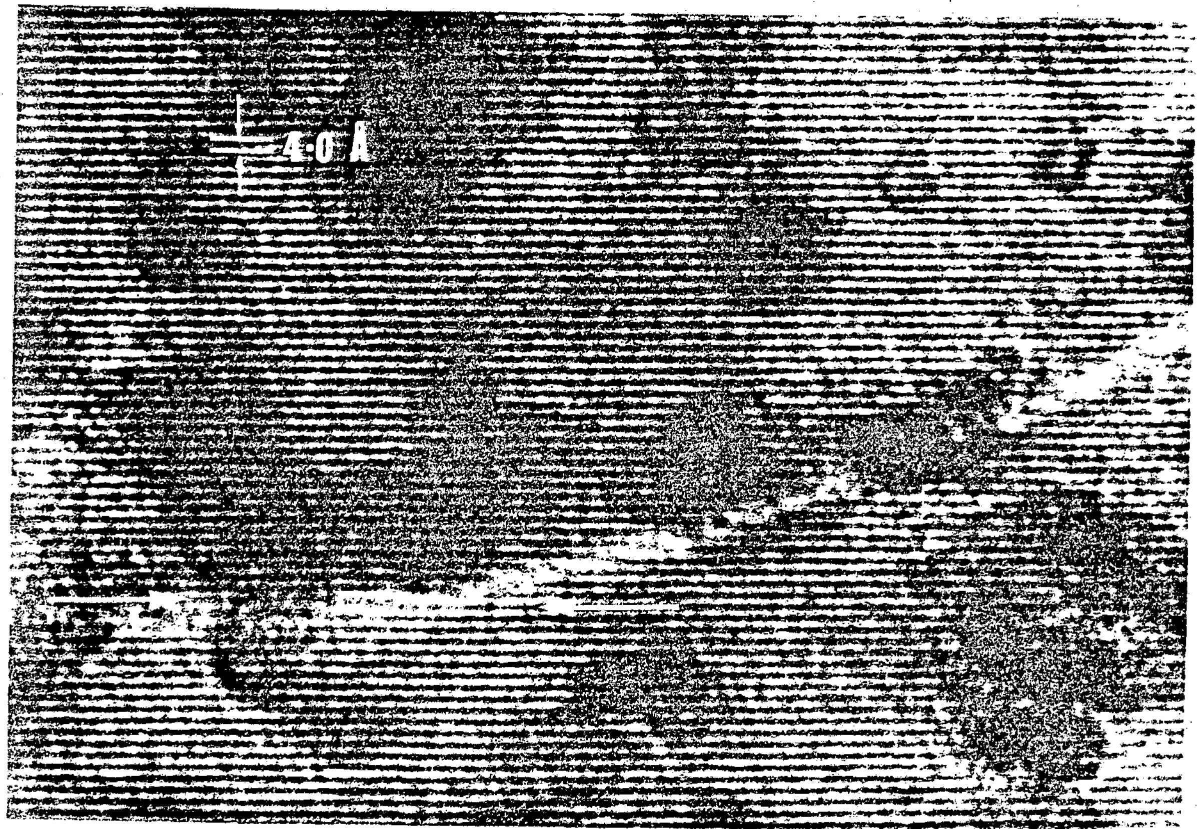
Fig. 2. Translation APB in ordered Ni_4Mo which becomes non-conservative in the region arrowed: (a) dark field image (b) lattice image. The superior information in the latter is evident.



b

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Fig. 2. Cont.

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