## Title

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# DIRECT EVIDENCE OF PRESENCE OF BOTH INTERSTITIAL AND VACANCY DISLOCATION LOOPS IN PLASTICALLY DEFORMED AND SUBSEQUENTLY ANNEALED MAGNESIUM OXIDE

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When magnesium oxide is deformed plastically most of the damage is introduced in the form of dislocation dipoles. On annealing these dislocation dipoles break up into rows of prismatic edge dislocation loops. As it is annealed further there is loop coarsening by self climb, prismatic slip (1) and bulk diffusion (1,2). Groves and Kelly (3) on the basis of electron diffraction contrast experiments concluded that most or all of the loops in plastically deformed and subsequently annealed foils are vacancy type. Cass (4) found that both interstitial and vacancy dipoles were present in as deformed magnesium oxide. By developing a contamination free technique of annealing thin foils otuside the electron microscope above ~ 1000°C and photographing the same area under identical diffraction conditions, the present authors were able to analyze precisely the mechanisms of annealing out the damage introduced by plastic deformation (1). The observations show in a direct way, not depending on diffraction contrast analysis, that both vacancy and interstitial loops are present after annealing of a deformed MgO foil.

Figure 1 is a set of pictures of the same area after the following annealing treatments: 1A → 1B, 27 min. at 1050°C; 1B → 1C, 34 min. at 1050°C. The set of pictures clearly shows the coalescence of a large elongated loop with a smaller loop of opposite Burgers vector by prismatic slip of the latter along its glide cylinder. After coalescence the part of the big loop (denoted by the arrow) breaks up pipe diffusion. A small loops is pinched off for the same reason that all dipoles tend to break up into circular loops particularly at their ends (5).

Figure 2 shows another set of pictures with the following annealing treatments: 2A → 2B, 76 min. at 1195°C, 2B → 2C, 38 min. at 1195°C; 2C → 2D, 30 min. At 6 there is an example where two dislocation loops are gliding due to their mutual interactions along glide cylinders that are at 90° to each other. Stereomicroscopy was done at each step of the picture making to locate the dislocation loops in the foil. Since both loops have "outside contrast" (image outside the extra half plane), they must have been of opposite type; one of them interstitial and the other vacancy. As can be seen in the last photograph when they finally came together they annihilated each other by rapid pipe diffusion even though the Burgers vectors were at 90° to one another. Pairs of loops at 1 2 3 4 and 5 (Fig. 2) are all similar pairs, either both vacancy or both interstitial type. Observations of interaction between opposite pairs were relatively rare. Contrast experiments similar to those reported by Groves and Kelly showed, in agreement with these authors, (3) that in thin foils annealed at high temperature ( 1300°C) for a long time almost all of the loops were vacancy type. Therefore, it was concluded that during plastic deformation of MgO, both kinds of dipoles are produced but vacancy type dipoles predominate. On long annealing all the interstitial loops are annihilated by prismatic slip and climb. Only the excess vacancy type defects are left.

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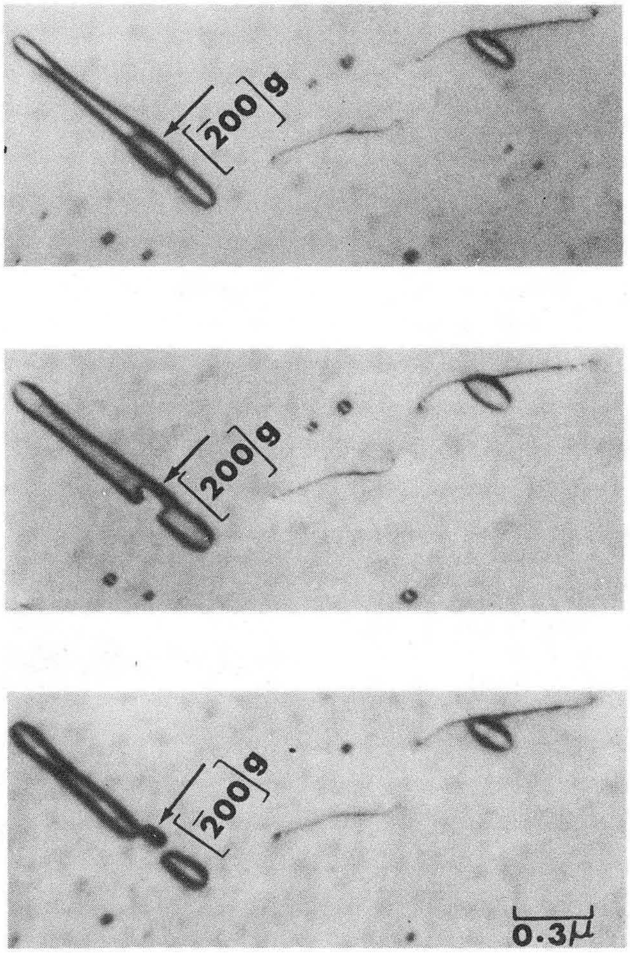


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Fig. 1.

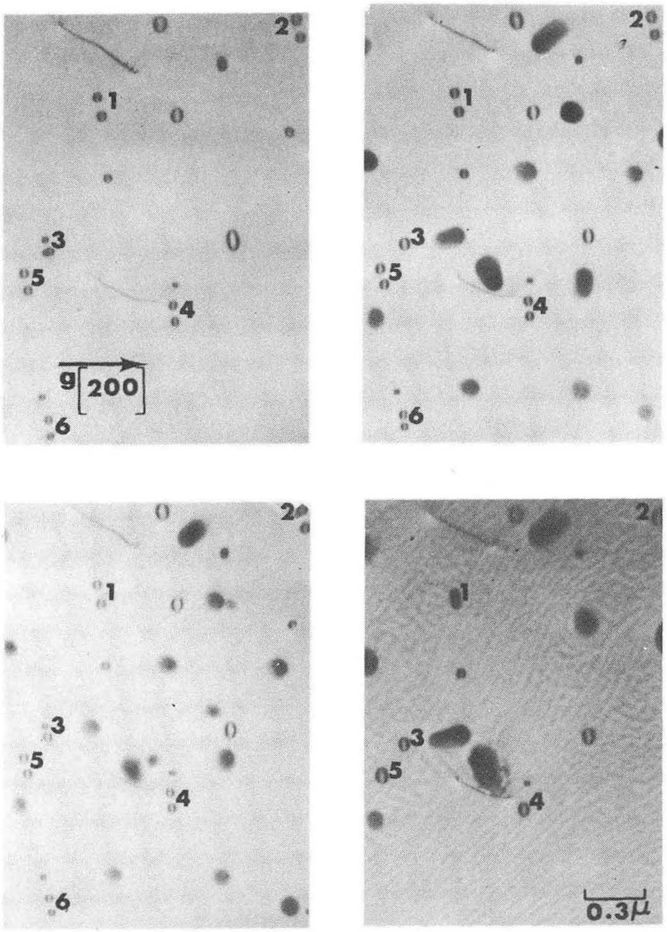


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Fig. 2.

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