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Point Defects and Radiation Damage in Platinum

OSCILLATORY VACANCY LOOPS

Platinum is a particularly attractive metal for lattice defect studies as it does not become very active when irradiated and its high melting point ensures that radiation damage does not anneal out completely at reactor temperatures. A recent transmission electron microscopy study by a group of Belgian workers (1) has provided remarkably convincing visual evidence of the type of defects existing in platinum foils after annealing, quenching, neutron bombardment, and fission fragment damage.

The dislocations in annealed platinum foils were dissociated; annealing twins were common and the general structural features were typically those of a face centred cubic metal with a medium-high stacking fault energy. Rapidly quenched foils exhibited spherical voids, some of which extended to the free surfaces. The authors of the paper suggest that because of the high surface energy of platinum these spherical cavities may find it difficult to transform to the vacancy loops common in baser metals.

Foils subjected to fission fragment radiation showed black spots indicative of defect clusters and fragments passing through the foil at very oblique angles sometimes caused straight line dot formations within the grains. Some of the vacancy loops oscillated slowly and jerkily between two limiting positions. This vibration was accomplished without energy dissipation; although shape and size changes occurred during movement the defect had the same size when it returned to its original position.

Quenched foils were damaged more rapidly by fission fragments than annealed material, thus supporting the hypothesis that damage is caused by vacancies rather than interstitials. The defect concentration was less along a denuded zone parallel to the twin boundaries.

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