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# ATOMIC RESOLUTION OBSERVATIONS OF THE POINT DEFECT STRUCTURE OF DEPLETED ZONES IN ION-IRRADIATED METALS *

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The point defect structure of individual depleted zones (DZs) created by a variety of different projectile ions, with energies in the range 15–90 keV, was studied employing the field-ion microscope technique [1–9]. The irradiations were performed in situ at a temperature of less than 15 K in the case of tungsten and 40 K for platinum. The fluence was always less then $10^{13}$ ions $cm^{-2}$, so that each depleted zone detected was created by a single energetic projectile ion. The following variables were studied: (1) the effect of varying the initial energy of the projectile ion at constant projectile mass; (2) the effect of varying the projectile mass at constant initial energy of the projectile ion; and (3) the non-linear effects produced by employing dimer ions ($W_2^+$ and $Ag_2^+$). The analyses of the depleted zones consisted of measuring and/or determining the following quantities: (1) the number of vacancies per DZ; (2) the spatial distribution of self-interstitial atoms around the DZs in the case of tungsten; (3) the dimensions of the DZs; (4) the vacancy concentration per DZ; (5) the radial distribution function of the vacancies within each DZ; (6) the radiation damage profiles due to the cumulative effects of many DZs; and (7) the non-linear effects produced by the dimer irradiations. The results are discussed and compared with different analytical theories and computer simulations of the primary state of radiation damage.

## References

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## Discussion

*J. Corbett:* Your work has masterfully examined the damage physics in tungsten and other metals. Would you comment on how these results transfer to semiconductors and to insulators?

*D. Seidman:* I would not want to extrapolate from our results on refractory metals to materials that are covalently or ionically bonded. The results apply to metals where the three-dimensional arrangement of

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vacancies has *not* collapsed into a lower energy configuration, such as a dislocation loop.

*Y. Quéré:* In the case of medium or high doses, did you observe superposition of cascades? If this is the case, did the superpositions favour the collapse of clusters into vacancy loops?

*D. Seidman:* The vast majority of our experiments were performed employing low doses ($10^{12}$–$10^{13}$ ions $cm^{-2}$). This was done so that we could associate each displacement cascade with a single ion. Hence, we never observed superposition of cascades. We did observe the collapse of cascades into dislocation loops when we increased the ion-irradiation energy in the case of both tungsten and platinum.