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# Damage Analysis and Fundamental Studies

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<i>Low temperature (4.1 °K) 14.8-MeV neutron irradiation of ordered and disordered CuPd provides a replacement to displacement ratio of 70. Postirradiation annealing indicates that interstitial migration is responsible for some reordering, but vacancy migration is the main mechanism.</i>	

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8. Damage Development and Hardening in 14-MeV Neutron Irradiation of Copper Alloys at 25°C (HEDL) 81

*Copper and copper alloyed with five atom percent of either aluminum, nickel or manganese were irradiated at 25°C with 14-MeV neutrons to fluences up to  $7.5 \times 10^{17}$  n/cm<sup>2</sup> (0.003 dpa). The radiation-induced microstructure of these materials was characterized by the coupled use of electron microscopy and microhardness. The radiation-induced microhardness changes were found to be independent of alloy identity and the magnitude of the solute-induced hardening. It appears that at least 70% of the defect clusters are too small to be resolved by microscopy (~1 nm). The point defects at 25°C which survive recombination and aggregate in either visible or invisible clusters constitute at least 9–10% of those produced in the cascades.*

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*mean crack propagation direction varying widely as the crack lengthens. The effect of helium irradiation of sufficient dose to produce large (diameter 120 nm) bubbles is to reduce the magnitude of the oscillations, reduce the mean value of the crack angle, and increase the crack-tip angle as a result of significant grain boundary sliding.*

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*From tests on a set of steels heat treated to exhibit a range of Luders strain  $\epsilon_L$  when tested in tension ( $\epsilon_L = 0.88\%$  to  $\epsilon_L = 5.40\%$ ) a quantitative correlation was determined between the Luders strain and the geometry of the lip around a ball indentation. Interferometric techniques were found superior to profilometric techniques for lip characterization. In addition, it was found that hardness/microhardness data were best correlated to the homogeneous plastic flow portion of the tensile stress-strain curve.*

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