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SYMPOSIUM ON POINT DEFECTS IN MATERIALS

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ATOM-SCALE STUDIES OF SOLIDS USING HYPERFINE INTERACTIONS

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We have investigated intermetallic compounds over 15 years through measurements of nuclear quadrupole interactions using the method of perturbed angular correlation of gamma rays, with radioactive probe atoms introduced at the ppb level. Three applications will be discussed: (1) Point defects arising due to deviations from stoichiometry and/or thermal activation can be distinguished by characteristic interactions; (2) Sublattices occupied by impurity probes can be identified from the magnitude and symmetry of measured electric field gradients; (3) Jump frequencies of diffusing probe atoms can be determined through relaxation of the nuclear quadrupole interaction. Such studies not only provide insight into atomistic phenomena such as defect agglomeration or switching of solute atoms between sublattices as a function of composition or temperature, but will be shown to yield measurables such as defect concentrations, activation enthalpies for defect formation and migration and for solute transfer between sublattices, and probe-atom jump frequencies.

(invited presentation)