Atom Jump Frequency in Compounds Measured Using Nuclear Quadrupole Relaxation

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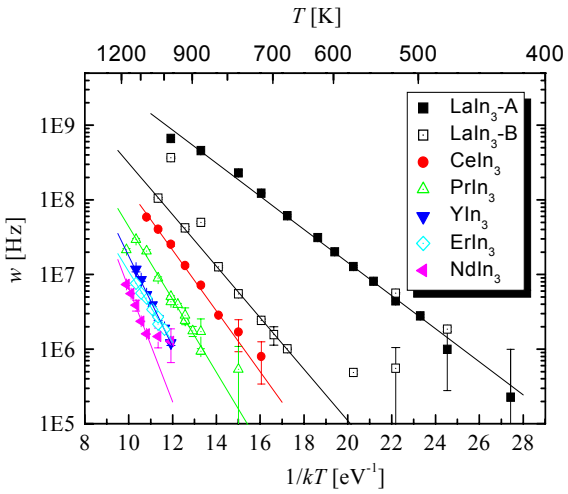
We have measured nuclear relaxation of ^{111}Cd tracer atoms jumping on the In-sublattice in In_3La [1] and In_3RE (RE= Ce, Pr, Nd, Er, Y), which all have the Cu_3Au structure, using perturbed angular correlation of gamma rays (PAC). For this sublattice, each near-neighbor jump leads to reorientation of the axis of the electric field gradient at the nucleus by 90°. Experimental perturbation functions were fitted using an exact stochastic model to obtain tracer jump frequencies. As will be shown, the jump frequency w determined using PAC is related to the diffusivity via $D = \frac{1}{12} f a^2 w$, in which f is the correlation coefficient and a is the lattice parameter. Results are shown in the figure, including two sets of jump frequencies for In_3La from measurements at more In-rich (A) and less In-rich (B) phase boundaries, which differ in composition by only about 0.1 at.%. As can be seen, set A has frequencies much greater than set B. Possible diffusion mechanisms will be discussed. This method is well suited for measuring atom movement at boundary compositions in "line" compounds provided there exists an EFG that reorients in each jump.



Finally, we note that the correlation coefficient can be determined from simultaneous measurements of w and D.

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[1] M.O. Zacate, Aurélie Favrot and G.S. Collins, Physical Review Letters (accepted).