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Shining light on atomic hopping processes - diffusion mechanisms in B2 alloys

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While diffusion is well understood for pure metals and for solid solutions, diffusion mechanisms in ordered intermetallic alloys are still under debate. Even for the simple case of B2 alloys, very little is known. As nearest-neighbour jumps would destroy the long-range order, effective jumps to further neighbouring shells have to be considered. Such jumps can either take place directly, where the atom has to overcome a large energy barrier, or as a fast sequence of nearest-neighbour jumps. The later can be described by different jump mechanisms among which the six-jump mechanism and the triple defect mechanism are most famous.

We use coherent X-rays to find wave-vector dependent relaxation times in different systems. By extending X-ray Photon Correlation Spectroscopy, which is the X-ray analogue of Dynamic Light Scattering, to wide angles [1], it is possible to gain information about diffusion in different materials [2,3,4]. In binary intermetallic alloys it is possible to determine the length and rate of effective atomic jumps. The ratios of jump-rates are compared to jump models.

This talk will give a brief introduction to atomic-scale X-ray Photon Correlation Spectroscopy and compare results about diffusion constants, activation energies and jump models as well as the influence of short-range order in the B2 systems Fe-Al and Ag-Mg.

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