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Positron trapping and annihilation in grain boundaries of µm and sub-µm grained polycrystalline materials

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Structurally complex materials provide many different possible trapping sites for positrons. Especially, positron lifetime spectra of samples with µm and sub-µm sized grains must be carefully analysed, as positron trapping and annihilation in grain boundaries plays an increasingly important role and cannot be neglected anymore, even when other defect types are in the primary focus. To properly evaluate such multi-component spectra, the diffusion-reaction model for positron trapping and annihilation in grain boundaries [1-3] is extremely useful. In this contribution, the existing model is extended to competitive trapping at two different types of intragranular defects in addition to the grain boundary. Closed-form expressions for the mean positron lifetime and the relative intensities of the defect-specific positron lifetime components are given. This model provides the basis for the correct determination of defect concentrations, especially for the inconvenient but common case that one intragranular defect type exhibits a lifetime component similar to that in grain boundaries. If in such a case one would not consider the grain boundary as positron trap, the determined intragranular defect concentration would be overestimated strongly even for µm-sized crystallites.

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Primary author: Prof. WÜRSCHUM, Roland (Institute of Materials Physics, Graz University of Technology)

Co-author: Mr BRUNNER, Philipp (Institute of Materials Physics, Graz University of Technology)

Presenter: Mr BRUNNER, Philipp (Institute of Materials Physics, Graz University of Technology)

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