Effect of rhenium on microscopic defects induced by He-ions irradiation in tungsten-based alloys

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In order to study the effect of transmutation element (Re) on the micro-defects of tungsten (W) in plasma environment, positron annihilation spectroscopy [1,2,3] was utilized to characterize the distribution of vacancy-type defects in W and W5Re alloys irradiated by He-ions beams with different energies and fluences (16 keV@5.8×10^{20} ions m^{-2} for W-1 or W5Re-1, 70 keV@1×10^{21} ions m^{-2} for W-2 or W5Re-2, 200 keV@2.4×10^{21} ions m^{-2} for W-3 or W5Re-3, respectively). It was found that when the irradiation dose was less than 10^{21} ions cm^{-2}, the distribution of vacancy-type defects in W5Re alloys was almost consistent with that in tungsten. When the dose increases, the effect of Re on the electron density distribution at the defect site becomes obvious. Positron annihilation lifetime results show that the defect concentration of the W sample added with 5 wt.%Re will be significantly higher than that of pure tungsten, while the longer lifetime value decreases significantly. Re will restrain the growth of vacancy-type defects to a certain extent, thus affecting the conformity between interstitial He atoms and vacancies, which will result in the strong display of helium information around the defect sites.

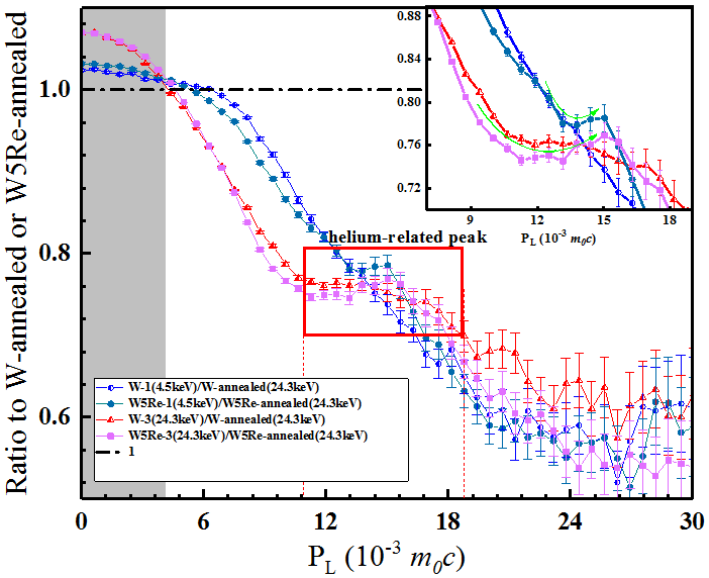

Figure 1 *CDB curves for W-1/W-annealed and W5Re-1/W5Re-annealed with a slow positron beam of 4.5 keV, and for W-3/W-annealed and W5Re-3/W5with a slow positron beam of 24.3 keV.*

References

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