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The Role of the Dislocation Nucleation Around Precipitates in the Mechanical Properties of a Fe-C Alloy*

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Abstract

The effect of the dislocation nucleation around the precipitates on the mechanical properties of a Fe-0.02 wt% C alloy has been investigated by tensile testing and by means of transmission electron microscopy, and an attempt has been made to correlate tensile data with the observed dislocation configuration. After ageing for 30 min at 400°C, dislocation loops or helical dislocations were seen around many precipitates. These loops seemed to be produced by the prismatic punching from the precipitate-matrix interface, because the mean atomic volume of the precipitate is larger than that of the matrix. When the ageing temperature decreased to 150°C, dislocation loops were seen only around some precipitates, and helical dislocations were rarely detected.

The variation of the yield drop which is deformed at room temperature with ageing temperature has a minimum at 400°C after ageing for 30 min. It has been suggested that the yield drop is associated with the dislocation nucleation around the precipitates when ageing or straining.

In deformation at liquid nitrogen the specimens either fractured before yielding or necked immediately after yielding and the specimens containing large precipitates were less ductile than those with small precipitates. The stress concentration due to dislocations nucleated around the precipitates during straining will cause a cleavage crack of a precipitate particle and this cracking will initiate cleavage microcracks in the adjacent matrix.

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