

Alloys and Intermetallics

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Bridging effect during stainless steels fracture

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Duplex stainless steels specimens were heat treated at 475°C for different times and pulled to failure. Fracture toughness testing was performed according to BS 7448, using a clip gauge to monitor specimen displacement. In addition, the direct current potential drop (DCPD) technique was used to monitor the crack propagation. The Crack Tip Open Displacement (CTOD) was evaluated. Computational data, Shear model, were fit to the experimental ones. Discrepancy was observed between the experimental data and the computational ones. The model was able to expect the crack tip open displacement (CTOD), experimental data , only within a certain range of the material hardness i.e. microstructure . In addition, the direct current potential drop technique was more sensitive to detect the crack propagation process than that observed for the clip gauge. The fracture mode was found to be dominated by transfers brittle fracture in ferrite phase. The crack avoided the ductile regions within the tested microstructure. Ligaments , 1-2mm in size, observed at the wake of the crack path and some identified grains exerted a bridging effect on the crack tip leading to an increase in the applied stress required to propagate the crack . Discontinuous cracking was observed specially just before the arrested crack tip. Twinning was observed in the vicinity of the cracks . It was shown that unfractured austenite grains bridged the crack plane. The bridging zone was typically several mm in length. Metallographic examination confirmed that the cracking propagates transgranularly in ferrite phase . Intergranular cracking mode was not observed .The austenite phase was rarely cracked and generally acted as a crack bridge or crack arrestor . Scanning electron microscopy and transmission electron microscopy (TEM) have confirmed brittle fracture in ferrite phase and ductile tearing off in austenite phase as cracking behavior.

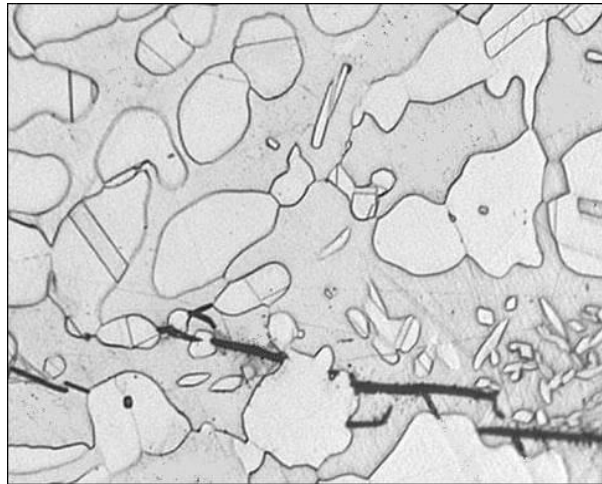


Figure 1.

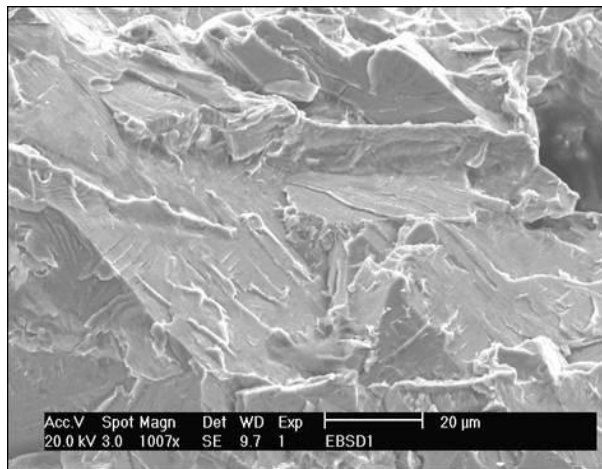


Figure 2.

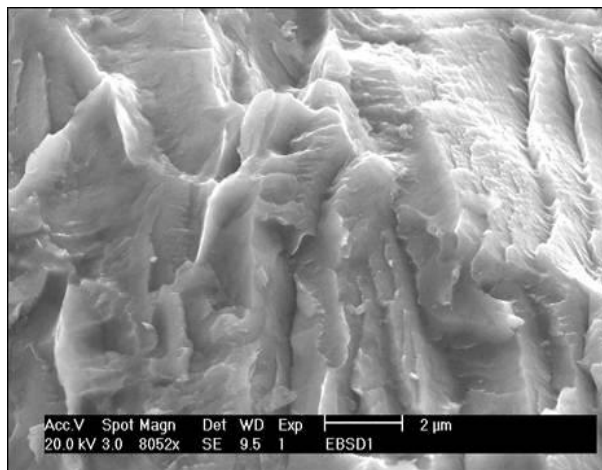


Figure 3.