Paragraph Ran in the Queries

Paper Title: Low cycle fatigue performances of Al0.3CoCrFeNi high entropy alloys: In situ neutron diffraction studies on the precipitation effects

Content :

Low-cycle behavior of the Al0.3 HEAs

The initial tension part and hysteresis loops (stress vs. strain) of the Al0.3 HEA samples under LCF with the strain amplitude of

±1%

are shown in Fig. 2. In Fig. 2(a) and (b), the hysteresis loops of the 1st cycle were symmetric in the Al0.3 HEAs with and without B2 precipitate. The yield strength of the FCC Al0.3 HEA was ~170 MPa, and the maximum stress at the strain of 1% was ~210 MPa, as presented in Fig. 2(a). The yield strength and maximum stress of the FCC + B2 Al0.3 HEA were ~350 MPa and 420 MPa, respectively, given in Fig. 2(b). The initial tension part of the Al0.3 HEA with the B2 precipitate showed work hardening while that of the Al0.3 with a single FCC phase had relatively low hardening behavior. An obvious increase of the maximum stress can be observed in the cyclic tensile stage, compared with the initial tension in both alloys. This trend indicates that the cyclic hardening occurred during the LCF of the Al0.3 at the strain amplitude of ±1%. It is worth mentioning that there were unexpected serrated flows on the plastic region of all the hysteresis loops, although the serrated flow usually occurred under the condition of high or cryogenic temperature and low strain rate (~10−3 or 10−4s−1) [[31], [32], [33], [34], [35], [36], [37], [38], [39]]. The hysteresis loops of different cycles are shown in Fig. 2(c) and (d) for the Al0.3 HEAs with an FCC phase and FCC + B2 phases, respectively. The increasing maximum stress of the single FCC sample until the 100th cycle indicates an obvious cyclic hardening during LCF. After the 100th cycle, the maximum stresses tended to stay at the same level. On the other hand, the hysteresis loops of the FCC + B2 sample showed a very similar shape without obvious cyclic hardening.

Low-cycle fatigue behavior by in situ neutron diffraction

The lattice-strain evolutions of different grain families of the Al0.3 HEAs along the loading direction during LCF are shown in Fig. 4. The lattice-strain evolutions are related to specific deformation mechanisms [46,47]. The lattice-strain evolutions of the {200}, {220}, and {331} grain families of the FCC Al0.3 along the loading direction during initial tension are exhibited in Fig. 4(a). The lattice strains in the initial tension

of the FCC Al0.3 increased linearly with the applied stress. The first vertical inflection of the lattice strain was observed at ~123 MPa in {311} and {220} grain orientations, while the inflection in {200} was horizontal. This feature indicates that the {200} grain family along the loading direction tended to share more load during the tensile deformation. The third vertical inflection was at the stress of ~158 MPa in the {200} grain family. This trend suggests the macro yielding of this alloy was strongly associated with the inflection point of the {200} grain family. Fig. 4(b) presents the lattice-strain evolutions of {200}, {220}, and {311} grain families of the FCC phase and {110},{200}, and {211} grains of the B2 phase in the FCC + B2 Al0.3 HEA during initial tension. The lattice strains of grain families of FCC {200} and FCC {311} turned upward firstly at ~350 MPa while others have horizontal inflections. The FCC {220} had its first upward trend at ~370 MPa. The macro yielding of Al0.3 HEA with B2 precipitates was associated with the yielding point of the FCC {200} which is also observed in the single FCC Al0.3 HEA. The grain families of B2 phase shared more load than the FCC phase, especially the B2 {200} grain orientation.