Paragraph Ran in the Queries

Paper Title: Plastic deformation and strengthening mechanisms in CoNiCrFe high entropy alloys: The role of lattice site occupancy
Content :

Mechanical properties

4.3.1. Tensile tests at room temperature

Fig. 5a compares the engineering stress-strain plots for the 5Fe and 10Fe alloys at room temperature. Interestingly, the 5Fe alloy shows a higher yield strength (YS) value of 970 ± 25 MPa than 850 ± 20 MPa for the 10Fe alloy. Compared to the 10Fe alloy, 5Fe alloy shows a higher ultimate tensile strength (UTS) of 1535 ± 30 MPa with comparable tensile ductility (18

±2

%). Thus, the 5Fe alloy shows a better strength-ductility trade-off than the 10Fe alloy. The fracture surface of both alloys shows dimples that are typical of ductile fracture (see supplementary Fig. S8a and b).

Compression tests at elevated temperatures

The high-temperature mechanical properties of the alloys are evaluated by performing a uniaxial compression test at different temperatures. The results are plotted as yield strength versus temperature for the 5Fe and 10Fe alloys and their comparison with reported high entropy alloys in Fig. 5b (Chang and Yeh, 2018; Pandey et al., 2019a; Tsao et al., 2017; Zhang et al., 2018). Both alloys show a different trend of YS variation with temperature. While 10Fe alloy shows a constant YS between 25 and 670 °C, 5Fe alloy shows a monotonous increment in YS and achieves a peak value of 1120 ± 30 MPa at 670 °C. However, beyond 670 °C, YS values in both alloys drop to ~ 700 MPa at 850 °C. The present 5Fe alloy performs better than other reported high entropy alloys till 800 °C.

YS strength of the present alloy is normalized with mass density and compared with reported Ni and Co-based superalloys (see Fig. 5c). The present alloys show specific yield strength (SYS) greater than 100 $MPa.gm^{-1}.cm^{3}$ till 750 °C. The SYS value of 121 $MPa.gm^{-1}.cm^{3}$ for the 5Fe alloy is comparable to IN718. This value increases to 140

MPa.gm^{-1}.cm^{3} at 670 °C, which is higher than those of commercial superalloys such as CMSX-2, CMSX-4, IN718, IN100 and MAR-M-247. Thus, the present 5Fe alloy shows comparable high-temperature compressive yield strength to 1st and 2nd generation of Ni-based superalloys.

Peak strength temperature (670°C)

cECCI was performed on the sample plastically deformed (ε_p) by 3.0 % under compression at the peak strength temperature of 670 °C. Fig. 8a shows the IPF map for the 5Fe alloy with grain-oriented close to 001 (marked as a dotted box) was chosen for further analysis. The ECCI micrograph under the two-beam condition of *g* =

$\bar{2}\bar{2}0$

shows channelling contrast from the γ′ precipitates (see Fig. 8b). The higher magnification images in Fig. 8c and supplementary Fig. S10a show deformation accommodation via three shearing mechanisms. The first shearing mechanism involves stacking fault formation. Some of these SF's are gliding on two different (111) planes and after interacting with each other they terminate within the precipitate (marked as solid magenta arrows). This dislocation interaction results in a stair-rod configuration that is sessile. The second shearing event leads to dislocation segments lying on the plane parallel to the cubic face, the (100) plane (marked as a solid yellow arrow). The third shearing configuration that accommodates plastic strain, forms a curved planar fault (marked as a solid red arrow). This curved planar fault is typical of APB configurationTo compare the deformation mechanism with the 5Fe alloy, 10Fe alloy was also subjected to plastic deformation by 3.0 (%). The IPF map along with 001 oriented grain selected for cECCI analysis are shown in Fig. 8d. A low magnification ECCI micrograph in a two-beam condition of g =

shows a strong channelling contrast within the precipitate (see Fig. 8e). High magnification ECCI micrographs for g =

diffraction condition showing precipitate shearing resulting in SF formation (see Fig. 8f and supplementary Fig. S10b). These SFs are extended across the precipitates.