Paragraph Ran in the Queries

Paper Title: Multi-scale ceramic TiC solves the strength-plasticity equilibrium problem of high entropy alloy

Content :

Calculated overall strength

Based on the above discussion, we list the contribution of various strengthening mechanisms to the yield strength of the alloy, as shown in Fig. 9. The yield strength values of the three alloys are 160 MPa, 305 MPa, 392 MPa, respectively. Remarkably, the predicted overall contribution of each individual mechanism to the strength (left column) aligns closely with the observed increment in alloy strength as measured by experimental data (right column). The $\Delta\sigma y=\Delta\sigma i + \Delta\sigma g + \Delta\sigma ss + \Delta\sigma d$ is the yield strength increment of $Al_{0.4}$ alloy matrix.For the $Al_{0.4}$-TiC (μm) alloy, the contribution of the second phase strengthening is only the strengthening caused by the dislocation cutting through the TiC (μm), resulting in $\Delta\ \sigma sp=\Delta\sigma\tau = 126.97$ MPa, The theoretical calculation value for $\Delta\sigma y$ is obtained as $\Delta\sigma y=\Delta\sigma i + \Delta\sigma g + \Delta\ \sigma ss+\Delta\sigma d+\Delta\sigma\tau = 325.25$ MPa. The second phase strengthening contribution in $Al_{0.4}$-TiC (μm + nm) can be attributed to both dislocations cutting through TiC (μm) and dislocation bypassing TiC (nm). Therefore, $\Delta\ \sigma sp=\Delta\sigma\tau+\Delta\sigma o = 212.34$ MPa, and we obtain a yield strength increment of $Al_{0.4}$-TiC (μm + nm) is $\Delta\sigma y=\Delta\sigma i + \Delta\sigma g + \Delta\ \sigma ss+\Delta\sigma d + \Delta\sigma sp = 412.07$ MPa can be obtained. The deviation between actual measurements and theoretical calculations can arise from various factors. Firstly, there exists a discrepancy in the dislocation density calculated by EBSD within a certain range, leading to an error in the contribution of dislocation strengthening provided. Secondly, we posit that the additional TiC (μm) providing shear strengthening resistance is in the form of plate-like second phase, whereas there exists a small amount of approximately spherical TiC (μm) in the actual microstructure. The spherical precipitate fails to provide dislocation cutting sites and instead contributes to dislocation bypassing or pinning. Consequently, there is a deviation in the calculation of strength increment for $Al_{0.4}$-TiC (μm) and $Al_{0.4}$-TiC (nm + μm) alloys.