

Understanding high temperature phenomena due to interaction between Metal and High Entropy Ceramics

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The interaction between Ni and High Entropy Carbide (HEC) ceramics was examined by the sessile drop method coupled with a contact heating procedure in vacuum (10^{-3} Pa). (VNbTaMoW)C, (VNbTaMoTi)C, (VNbMo_{0.4}TaTi)C single phase high entropy ceramics were used as substrates to investigate the wetting process. For all substrates, the contact melting between Ni and HECs was observed at the lower temperature (1400°C) than melting point of pure Ni (1455°C). It was shown that Ni demonstrates good wetting with all HEC substrates forming a final contact angle of 0°-5° in 5 min. Structural characterization of solidified Ni/HEC couples evidenced that dissolutive wetting mechanism was responsible for very good wetting. Complex dissolution–reprecipitation phenomena are responsible for forming the final microstructure of the solidified drop and interfacial region. It is shown that at the initial stages of crystallization, crystals based on NbC and TaC are formed first due to its highest melting point. The main phases in the drop region after its final crystallization were (Nb,Ta)C_{base}, (Mo,V)C_{base}, intermetallic phases Ni₃Ti or Ni₄Mo and Ni-based solid solution. At the same time, Ni penetrated into the substrate due to grain boundary diffusion and wetting. The low final contact angle (~5°), dihedral angle (~10°), fast drop spreading (less than 5 min) made the Ni a suitable for fabricating HEC-based cermets that can be used as cutting tools, bearings and materials for extreme working conditions.

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