

Research on corrosion and hydrogen embrittlement in additive manufacturing high-entropy alloy

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Abstract This work tuned the microstructure of laser powder bed fusion (LPBF) CoCrFeMnNi HEAs by different heat treatment processes to improve the corrosion resistance in the simulated proton exchange membrane fuel cells (PEMFCs) environment. Research indicated that different substructures influenced the electrochemical corrosion and passive behavior of the material. The corrosion resistance was improved with increasing heat treatment temperature, which was attributed to the compositional homogenization from optimized structure, avoiding Cr depletion at grain boundaries and forming a better protective passive film. Moreover, the LPBF CoCrFeNiMn HEA shows excellent resistance to hydrogen embrittlement. Unsuitable LPBF parameters are accompanied by many microcracks and holes, resulting in a slight decrease in the hydrogen embrittlement resistance of the material. The electron backscatter diffraction (EBSD), electron channeling contrast image (ECCI) techniques, and transmission electron microscope (TEM) were carried out to research the main influencing factors of hydrogen on the deformation mechanism and crack propagation. Although unsuitable process parameters will trigger fabrication defects and reduce mechanical properties, the cellular structure can bring a hydrogen-induced strain hardening platform for LPBF CoCrFeNiMn to reduce the damage caused by hydrogen embrittlement.

Keywords High-entropy alloy, Additive manufacturing, Corrosion behavior, Hydrogen embrittlement

Reference

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