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Rapid densification of cubic AlCoCrFeNi high-entropy alloy via combining high-pressure field-assisted sintering and ultra-fast high temperature sintering

High-entropy alloys (HEA) are promising candidates as low-cost and precious metal-free catalysts for the alkaline exchange membrane (AEM) electrolysis. For this application, sputtering targets which require a pure phase composition, homogeneous microstructure, and high density, can be produced via FAST/SPS.

However, there is a challenge of sintering a single phased HEA without unwanted pore and secondary phase formation. These restrictions are caused by the pressure limitation of the tool material graphite and by the applied sintering temperature. Low temperatures result in low density and high porosity, while high temperatures lead to element-rich secondary phases that deteriorate the mechanical properties.

In this work, a combination of two innovative sintering processes, high-pressure field-assisted (HP-FAST/SPS) and ultra-fast high temperature sintering (UHS), serves as a remedy. A ball-milled HEA AlCoCrFeNi is utilized and the effects of different HP FAST/SPS pressures and UHS currents on the microstructure, phase composition, and hardness are characterized. A densification of up to 98%, a hardness of 800 HV 0.5, and a homogeneous single-phase structure without impurities is achieved within an UHS sintering time of only 30 s. In addition, a desired phase transformation from BCC to FCC can be specifically adjusted by increasing the UHS current. This new approach emphasizes the potential of the investigated HEA AlCoCrFeNi as a suitable catalyst for the AEM electrolysis.

Professional Status of the Speaker

Doctoral or Master Student

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No

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