Effect of Fabrication Method on Phase Formation and Hydrogen Absorption in TiVNbCrMnFe High-Entropy Alloy

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Abstract. The effect of processing route on the microstructure, phase composition, and hydrogen absorption behavior of the TiVNbCrMnFe high-entropy alloy was investigated. The alloy was prepared by mechanical alloying using a planetary ball mill (BM) and arc melting (AM), resulting in distinct structural states. The BM sample consists of nanostructured particles with a predominantly face-centered cubic (fcc) phase, while the AM sample exhibits a dendritic microstructure with a combination of hexagonal and body-centered cubic (bcc) phases and evident elemental segregation. Despite the refined microstructure of the BM sample, no measurable hydrogen absorption is observed at 35 °C. In contrast, the AM sample demonstrates hydrogen uptake of up to 0.9 wt.% under the same conditions, with a continuous pressure–composition behavior and no distinct plateau. The difference in hydrogen absorption behavior is attributed primarily to the phase constitution. The presence of the bcc phase in the AM sample, enriched in Ti and V, is likely responsible for enhanced hydrogen uptake, whereas the fcc phase in the BM sample limits hydrogen solubility and diffusion. These results highlight the dominant role of phase composition over microstructural refinement in controlling hydrogen absorption properties of TiVNbCrMnFe alloys and demonstrate the importance of processing route in tailoring functional performance.