Thermally Grown Entropy-Stabilized Oxide Coating from a Valve Metal-Based Complex Concentrated Alloy

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Abstract The enhanced compositional flexibility of complex concentrated materials, which can incorporate multiple-principal elements, provides the opportunity to explore a wider range of compositions and unconventional properties in multifunctional materials. Complex concentrated oxides (CCOs) have demonstrated attractive functionalities in energy storage and catalysis applications, motivating the expansion of the boundaries of CCOs with accessible compositions and unique properties. However, the development and utilization of CCOs, especially in large-scale applications at high temperatures, pose significant challenges due to limited design strategies and fabrication techniques. To address these challenges, we develop a new complex concentrated alloy (CCA) AlCrTiVNi5 screened from the valve metal group. Our approach has yielded a thermally grown (TG-)CCO that has not been previously reported, which demonstrates unique thermomechanical properties, including high thermodynamic stability, low thermal expansion, high fracture tolerance, and an excellent combination of strength and ductility. These initial findings are expected to offer fresh perspectives on designing and developing advanced materials that boast exceptional functionality and versatility.