



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

High entropy alloys (HEAs) are a novel class of alloys that contain multiple principal elements. HEAs possess high mixing entropy that inhibits the formation of multiple phases in them by reducing their Gibbs free energy, especially at high temperature. Refractory high entropy alloys (RHEAs) generally have BCC structure and possess very high mechanical strength at elevated temperatures. Transition metal HEAs contain transition elements. In this research work, two RHEAs such as WMoVCrTa and $W_{23}Mo_{23}V_{17}Cr_8Ta_7Fe_{22}$, and one Al and Cu contained transition metal HEA such as $(Al)_{10}(FeCoNiCu)_{90}$ were designed based on alloy design criteria of Guo et al. and Takeuchi et al., and fabricated subsequently. To minimize the difficulties in processing the alloys, mechanical alloying by ball milling was done prior to the consolidation. Milling characteristics of the alloys were established. The milled WMoVCrTa powder revealed two BCC phases. The milled $W_{23}Mo_{23}V_{17}Cr_8Ta_7Fe_{22}$ powder revealed a single BCC phase. The milled $(Al)_{10}(FeCoNiCu)_{90}$ powder revealed two FCC phases such as FCC1 and FCC2. The as-milled WMoVCrTa and $W_{23}Mo_{23}V_{17}Cr_8Ta_7Fe_{22}$ powders were cold compacted followed by vacuum arc melted and heat treated, whereas the milled $(Al)_{10}(FeCoNiCu)_{90}$ powder was cold compacted and sintered to fabricate the alloy ingots. The structure, mechanical and tribological properties of the alloys were determined. The two RHEAs show very high mechanical strength at room and elevated temperatures. WMoVCrTa and $W_{23}Mo_{23}V_{17}Cr_8Ta_7Fe_{22}$ respectively exhibited yield strength retention of 79% and 90% of the room temperature value, at 1000 °C. They also have reasonable ductility both at room and high temperature, and very high hardness. The $Al_{10}(FeCoNiCu)_{90}$ exhibits high mechanical strength and ductility. The two RHEAs have higher wear resistance than that of high-speed steel (HSS). The good mechanical and tribological properties possessed by these alloys indicate that they are viable materials for high temperature applications.