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# Design and Study of High Entropy Alloys for Next Generation Beam Windows

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Targets and beam windows are currently the limiting factors for beam power and runtime for high energy particle accelerators. Thermal shock and fatigue are the primary modes of failure for these components, which is accelerated by irradiation damage from the beam. To achieve the desired increase in beam power and runtime, new materials need to be explored and studied. High Entropy Alloys (HEAs), also known as Compositionally Complex Alloys (CCAs), are a novel class of alloy that have exhibited remarkable strength and radiation resistance In this study, we develop novel low-density refractory CCAs by coupling CALPHAD-based thermodynamics predictions with traditional alloying principles. Beginning from a previously studied single phase BCC CrMnV ternary (alloy 1), small quantities of Ti was added to act as an impurity getter (alloy 2); Al was added to decrease density (alloy 3) and, with added Co, to promote a coherent B2 phase resulting in strengthening with minimal embrittlement (alloy 4). The first iterations of these alloys have been manufactured and characterized with SEM, TEM, micro and nanoindentation for both as-cast and ion-irradiated samples. In parallel, a study of the effects of nanocrystallinity on the radiation tolerance of beryllium, a current generation window material, is being conducted and will be outlined.

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