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# Advanced Material Development for Next Generation Accelerators

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Beam-intercepting devices face challenges of beam-induced thermal shock and radiation damage effects. Efficient cooling systems are needed to remove heat as beam power increases. Development of novel materials capable of sustaining increased beam power and intensity is crucial for future multi-MW target facilities. In this talk, several promising novel materials will be discussed, including High Entropy Alloys (HEAs), Nanofibers, SiC-SiC composites, and Toughened Fine-Grained Recrystallized (TFGR) tungsten. These materials offer potential solutions for the challenges faced by next-generation accelerator facilities. HEAs, for instance, demonstrate enhanced radiation tolerance compared to conventional alloys, making them valuable for high-energy physics (HEP) applications. Nanofibers, known for their thermal shock and radiation damage tolerance, are being investigated as target materials, with their numerous grain boundaries and free surfaces acting as sinks to irradiation-induced defects. Initial studies show promising potential for nanofibers in future target materials. Another material known as SiC-SiC composite is being explored as an alternative to graphite in proton beam target applications. SiC-SiC composites exhibit superior oxidation resistance compared to graphite, reducing the need for extensive oxidation prevention measures. Preliminary findings suggest that SiC-SiC composites offer promising potential for improved performance and simplified maintenance in high-power accelerator facilities. TFGR (Toughened Fine-Grained Recrystallized) tungsten is being investigated as a next-generation target material due to its potential to offer 10 times higher muon/neutron brightness compared to current materials. Although tungsten has inherent brittleness at low temperatures, this challenge can be overcome through the application of various metallurgical techniques. The exploration of TFGR tungsten presents an opportunity to enhance the performance and efficiency of muon/neutron generation while addressing the brittleness issue associated with tungsten. In conclusion, the exploration of novel materials such as High Entropy Alloys, Nanofibers, SiC-SiC composites, and TFGR tungsten offers promising solutions for the challenges faced by beam-intercepting devices. Further research and development in these areas are essential to enhance the performance and reliability of next-generation accelerator facilities.

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