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High-Power Targetry R&D for Next-Generation Accelerator Target Facilities

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Beam-intercepting devices such as beam windows and particle-production targets are critical components of accelerator target facilities for High Energy Physics (HEP) experiments. The high-power, pulsed structure of the particle beams used for these experiments leads to thermal shock and high-cycle fatigue in addition to radiation damage resulting from the accumulated particle fluence. This can lead to degradation of the target system's mechanical and thermal properties; considerably reducing their lifetimes and presenting substantial challenges to reliable operation of multi-MW class facilities. Recently several major accelerator facilities have been forced to operate at reduced power levels due to target survivability concerns. Furthermore, at Fermilab it is planned to increase the neutrino production beam power up to 2.4 MW in coming years. Therefore, timely R&D on the irradiated behavior of target system materials is critical to efficient operation of accelerator facilities and full utilization of recent accelerator power upgrades for HEP research. This talk will begin with an overview of high-power targetry, and the significant challenges presented by beam power increases expected for future HEP experiments. We will then cover several past materials irradiation studies that have been completed by the High-Power Targetry R&D group at Fermilab and its collaborators on common accelerator and target materials such as graphite, beryllium, titanium, and tungsten. Finally, we will conclude with a discussion of two novel materials investigations under way within the group; high-entropy alloys for beam window applications, and electrospun nanofibers to serve as particle production targets.

Working Group

WG 3: Accelerator Physics

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