50 kW Prototype of the High Power Production Target for the FRIB*

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The Facility for Rare Isotope Beams (FRIB) is now under construction at Michigan State University. One of the major challenges for the FRIB is the design and integration of the production target in which rare isotopes are produced via the fragmentation and fission of 400 kW primary beam of heavy ions with 200 MeV/u energy for uranium and higher energies for lighter beams. The high power operation requires the target should withstand during 2 weeks of service the deposition of up to 100 kW continuous power from a primary beam delivered in a 1 mm diameter beam spot, that leads to up to 60 MW/cm^3 peak power density if static target is used. A rotating carbon disk with multiple slices is selected as a baseline concept for the Production Target. Multi-slice design with slice diameter 30 cm and the rotational speed 5000 rpm allows the target to avoid destruction under the beam impact and to increase the useful area of heat dissipation by thermal radiation, limiting the operational temperature by 1900 °C. A prototype designed for 50 kW power has been built to validate the target concept chosen. It consists of 5 graphite slices assembled inside the vacuum chamber. Water-cooled copper heat exchangers are inserted between the slices to absorb the radiated power from each slice. The prototype was successfully tested with high energy electron beam at Budker Institute of Nuclear Physics, Novosibirsk, Russia, in order to simulate the thermal and mechanical conditions of the FRIB production target operation. During the test a nominal power deposition of 10 kW per slice was reached with a maximum slice temperature of 1600 °C. The test and the extensive numeric simulations performed validated thermal and mechanical aspects of the multi-slice target design and provided valuable input for the production target final design.

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