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Measurement and optimization of the beam coupling impedance of a novel 3D-printed titanium alloy cage inside the thin-wall vacuum chamber

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Dipole magnet vacuum chambers are among the critical and costly components of rapid-cycling accelerator facilities. Alternative approaches to traditional ceramic chambers have been explored for the implementation of fast-ramping dipole-magnet vacuum chambers, including thin-wall metallic beam pipe chambers strengthened with transverse ribs. Here, we report a novel 3D-printed titanium alloy cage inside the thin-wall vacuum chamber, which is designed for HIAF project to reduce manufacturing difficulty and cost, shorten the production cycle, and improve the quality. Because the beam impedance aspects are highly important for beam stability, comprehensive studies were undertaken to characterize the impedance of the 3D-printed titanium alloy cage inside thin-wall vacuum chamber. The beam-coupling impedance of the new thin-wall vacuum chamber were studied numerically. Strategies for further reducing the beam-coupling impedance were explored. In addition, impedance bench measurements using the "half wavelength"resonant method were conducted to identify the longitudinal and transverse impedance of this thin-wall vacuum chamber prototype experimentally. The simulated and measured results for the impedance were consistent. Furthermore, a campaign for resonance-check measurements on this thin-wall vacuum chamber prototype was launched. This novel thin-wall vacuum chamber structure has been ready for installation in the Booster Ring (BRing).

Footnotes

Funding Agency

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