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Study on the vacuum properties of titanium alloy-lined thin-walled arc vacuum chamber

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A large scientific facility, High Intensity heavy-ion Accelerator Facility (HIAF), was being built to study basic and interdisciplinary sciences. The Booster ring (BRing), as the core device of the HIAF, has a magnetic rigidity of up to 34 Tm, and the field ramping rate of the pulsed dipole magnet is up to 12 T/s. To reduce the eddy current effect and beam loss caused by the rapid ramping of the magnetic field. A 0.3 mm stainless steel thin-walled titanium alloy lined arc vacuum chamber was proposed, in which titanium alloy liners are sequentially arranged inside to improve mechanical properties. The arc vacuum chamber with a cross-section of 230 mm x 97 mm and a length of 3.4 m, to reduce the pressure gradient inside the thin-walled arc vacuum chamber, Ti-Zr-V thin films were deposited on the titanium alloy liner and 0.3 mm stainless steel thin wall, respectively, by magnetron sputtering coating technology. After activation of Ti-Zr-V thin films, the ultimate pressure can be as low as 5.0E-10 Pa, and the pressure at the middle of the thin-walled arc vacuum chamber could decreased from 1.5E-9 Pa to 6.6E-10 Pa. Furthermore, 0.3mm thin-walled titanium alloy lined arc vacuum chamber and Ti-Zr-V thin films have been successfully applied to HIAF-BRing.

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