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Tribological and electrical characterization of Ag/Rh coating pair for sliding RF contact application for ITER

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Radio-Frequency (RF) contacts are key components on the International Thermonuclear Experimental Reactor (ITER) Ion Cyclotron Resonance Heating (ICRH) antenna, and these components are facing big challenges such as 2kA operation current load and severe wear at around 200 °C in high vacuum. Stainless steel 316L and CuCrZr are proper candidates to be applied as the base materials for the conductor and the RF contacts louvers respectively. Functional coatings are planned to be applied both on the surfaces of CuCrZr and 316L for the purposes of wear prevention, oxidation protection and contact resistance optimization. Owing to their excellent thermal and electrical conductivities, Rh and Ag were selected and electroplated on the 316L and CuCrZr substrates as functional coatings. As a high vacuum machine that reaches to 10⁻⁶Pa, before operation, ITER vacuum chamber is mandatory to be baked at around 250 °C for vacuum conditioning. In order to study the effects of long time thermal ageing on the Ag/Rh coating pairs, 500h baking at 250 °C under 10⁻⁶Pa vacuum condition was performed and the materials properties change as well as the diffusion phenomenon between Ag/Rh were characterized. In addition, the electrical and tribological performance of Ag/Rh contacting pair have been carefully studied on a dedicated test bed, which was developed by integrating ITER ICRH RF contacts' realistic working conditions such as high vacuum and high temperature. The results obtained can be helpful for ITER to choose the optimal RF contact coating material and can be referred by other RF contacts development which are working at high temperature under vacuum.

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