Fundamental study for practical applications of Ti-Zr-V NEG coating to general vacuum systems

Makoto Okano[1)], Akira Niwata[1)], Shin-ichi Kitamura[1)], Yasunori Tanimoto[2)], Xiuguang Jin[2)], Masahiro Yamamoto[2)], Tohru Honda[2)]
1) JEOL Ltd., Akishima, Japan
2) High Energy Accelerator Research Organization (KEK), Tsukuba, Japan

Modifying the properties of surfaces has become essential to obtain a desired function in various ultra high vacuum (UHV) systems. Among such techniques, Ti-Zr-V non-evaporable getter (NEG) coating, originally developed at CERN[1,2)] and being widely applied to particle accelerators, is one of the most promising functional coatings, as it provides high effective pumping speeds, low outgassing rates, and low secondary electron yields. Since these desirable properties are beneficial in any UHV systems, there has been an increasing demand for its widespread availability. Furthermore, NEG coating is expected to maintain UHV conditions in power-less situations; for example, its application to electron microscopes might enable long-sustained transportation and quick recovery to UHV. For these practical applications to general vacuum systems, we have started a fundamental study on NEG coatings, where the vacuum properties are measured by a build-up method and the durability of the pumping capacity is examined by repetitive cycles of air-exposure and activation. In order to establish a technique to deposit high-performance films on various vacuum chambers by magnetron sputtering, the coated surfaces are characterized by scanning electron microscope (SEM), energy dispersive X-ray spectrometry (EDS), and X-ray diffraction (XRD). The test tubes used in the build-up experiment are made of 304 stainless steel and measures 50 mm in diameter and 300 mm in length. One tube is coated with 0.7um Ti-Zr-V films and the other is uncoated. After 24 hours of stopping the sputter ion pump (SIP), the pressure in the uncoated tube increased from 2E-8Pa to 3E-6Pa, while the increase was suppressed from 6E-9 Pa to 1E-8Pa in the coated tube. Even

after an additional build-up for 10 days, the coated tube was maintained under UHV conditions (7E-6Pa), and the pressure was recovered to 5E-8Pa in 5 hours after switching on the SIP. A comparison by residual gas analysis after the 24-hour build-up showed that the NEG coating improved 360-times for CO and 100-times for H_2. These results suggest a feasibility of the transportation of UHV systems without electricity. The presentation will include preliminary results of film characterization by the surface analyses, as well as pumping properties of the NEG coating.

References

1) C. Benvenuti et al., Vacuum 60 (2001) 57.
2) P. Chiggiato and P. Costa Pinto, Thin Solid Films 515 (2006) 382.