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Surface Characterization of Zr-O/W System at ~1700 K

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Surface properties of Zr-O/W(100) system, which has been widely used as a thermal field emitter of high emission stability, has been studied to understand the mechanism of lowering of work function as well as the stability performance as an emitter under operating conditions (~1700 K, ~10^{-6} Pa).

The surface characterization of Zr-O/W(100) low work function surface by Auger electron spectroscopy (AES), ion scattering spectroscopy (ISS) and reflection high energy electron diffraction (RHEED) measurements technique at high temperature was performed. Adsorption of Zr onto W(100) followed by heating at ~1710 K in oxygen partial pressure of ~2.7×10^{-4} Pa causes rapid diffusion of Zr into the bulk and the formation of a tungsten oxide layer. Heating in vacuum results in desorption of the tungsten oxide and segregation of Zr onto the surface. Zr segregated on the top, associated with oxygen-atoms just beneath the Zr-atoms being weakly coupled with the Zr-atoms. This weakly coupled chemical state has been revealed by the appearance of a tiny hump at ~130 eV in Zr-AES spectrum. Furthermore, the AES clearly indicates that major part of oxygens except those coupled with Zr-atoms does exist a little bit deeper in the W(100) substrate.

RHEED-observation has also revealed that surface structure of the Zr-O/W(100) system undergoes particular reversible processes depending on the sample temperature, leading to a new aspect of surface properties at high temperature.

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