Work Function Measurement of Er-oxide/W(100) Surface by using of Photoemission Electron Microscope

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Abstract. A cathode material of a low work function is needed to achieve a high performance electron source. We measured the work function of W(100) surface modified with Er_2O_3 by using of photoemission electron microscope. The work function of Er-oxide/W(100) surface is measured to be 2.86eV. The work function of ZrO/W(100) thermal-field emission cathode has been reported to be 2.7~2.9eV. A work function of a cathode is generally estimated by Fowler-Nordheim plot (F-N plot). However, there are some ambiguities in this method. The work function measured by using of photoemission electron microscope (PEEM) is come from photo-electron emission phenomena. And the sample surface can be observed. These advantages on measurements make search of low work function materials easier. Therefore, we measure the work function of W(100) surface modified with Er_2O_3 by using of PEEM. The sample used in this experiment is a circular (100) oriented single crystal tungsten plate of 8mm in diameter and 0.1mm in thickness. A small amount of Er_2O_3 powder was dissolved in ethanol, and it is put on the sample surface. The sample was heated up to 2000K by electron bombardment in PEEM chamber of 10^{-8} Pa and the low work function surface was realized on the planar surface. The each PEEM images that the sample is irradiated with the light of wavelength from 300nm to 460 nm every 20nm are taken. In this study, the work function was estimated with the Fowler plot for the emission current density. However, the PEEM system cannot measure directly the emission current. Thus, we estimated the emission current density from the local brightness of the photoelectron image.
The work function of Er-oxide/W(100) is measured in optical method by using PEEM. Fowler plot is used for estimating the work function of room temperature from PEEM data. The estimated work function of W(100) single crystalline surface modified with Er_2O_3 is 2.86eV.

Keywords: Erbium oxidex; Work function; Photoemission Electron Microscope.