

Fabrication of Tungsten Carbide Films by Filtered Pulse Arc Deposition with Cemented Tungsten Carbide Cathodes

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Abstract

Tungsten carbide films (W-C films) were fabricated on silicon substrates by using the filtered pulse arc deposition (FPAD) method. Two types of cemented tungsten carbide (WC) were used as cathode, one containing Co and the other Ti, which were used as binders for forming the cathode shape. The films were fabricated by varying the pulse arc current and substrate bias voltage. The discharge, deposition and film properties were investigated under these deposition conditions. The cathode wear amount when using WC-Co (WC cathode containing Co) was found to be smaller than that measured when WC-Ti (WC cathode containing Ti) was used. The W-C film thickness was approximately 30 - 40 nm under all conditions, except when the pulse arc current was 50 A and the film thickness, was approximately 10 nm. Compared to the WC-Ti, the consumption of cathode material is suppressed in the WC-Co, indicating that the efficiency for film preparation of the latter is good. From the X-ray diffraction analysis, the crystalline phase of W-C films fabricated using WC-Co and WC-Ti were observed as W_2C and WC_{1-x} , respectively, indicating that different crystalline phases could be fabricated using different cathodes. From the X-ray photoelectron spectroscopy analysis, the oxidation layer formed by air exposure was observed to exclusively exist on the W-C film surface. Moreover, almost all oxygen in the oxidation layer bonded with tungsten.

Keywords

Cemented Tungsten Carbide Cathode, Thin Film, Filtered Pulse Arc Deposition