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Improvement of Sprayed Coatings with Ultra High Voltage EB Melting†

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KEY WORDS :(Sprayed Coating), (Ultra High Voltage EB), (Vickers Hardness)

The application fields of spraying technology is broadening widely because of easy formation of many kinds of thick coatings from metals to ceramics. However, there is a limitation of application for protection coatings, because porosities and impurities are formed in conventional spraying method. In order to improve the properties of sprayed coatings, low pressure spraying or laser-plasma spraying has been developed. In this note, alloying layers were formed with melting sprayed coatings by 500kV ultra high voltage electron beam and their characteristics were described.

Experimental Method

Spraying materials of 80%Ni-20%Cr alloy powder and Ni based self-fluxing alloy powder (Bai. Ni, 14%Cr, 4%Fe, 3%Si, 3%B) were used. Base metals were SUS304, SS41 and SK4 steels, whose surfaces were blasted with fused alumina. Powder spraying device with Oxygen-Acetylene gas heat source was used for spray coating.

Sprayed coatings were melted with 500kV ultra high voltage electron beam heat source shown in Fig.1 (beam current: 1-15mA, beam diameter: 5-6mm, gas pressure: 1 $\times 10^{-2}$Pa).

Hardness of EB melted sprayed coatings were tested with Vickers hardness tester. Macro structure of the coatings was observed with an optical microscope and analyzed with an electron beam micro probe.

Results

Cross sections of melted bead of self-fluxing alloy coatings of 0.2mm in thickness which was frame sprayed and electron beam melted are shown in Fig.2. Figure 3 shows the macro structure by microscope in melted bead cross sections of Ni-Cr alloy coating and self-fluxing coating of about 0.1 mm in thickness. No defects such as porosities was seen and materials are uniformly mixed. Especially, a solidification layer is formed which is not found in the coatings as sprayed.

EPMA results for melted bead of sprayed coatings with self-fluxing alloy shown in Fig.2(c) are recognized an alloying layer where Ni, Cr and Fe are uniformly distributed. Vickers hardness of the bead of self-fluxing alloy was Hv: 400-550.

The alloying layers having the merits of sprayed coatings and low porosity rate with the combination processing method of thermal spray and ultra high voltage electron beam melting.

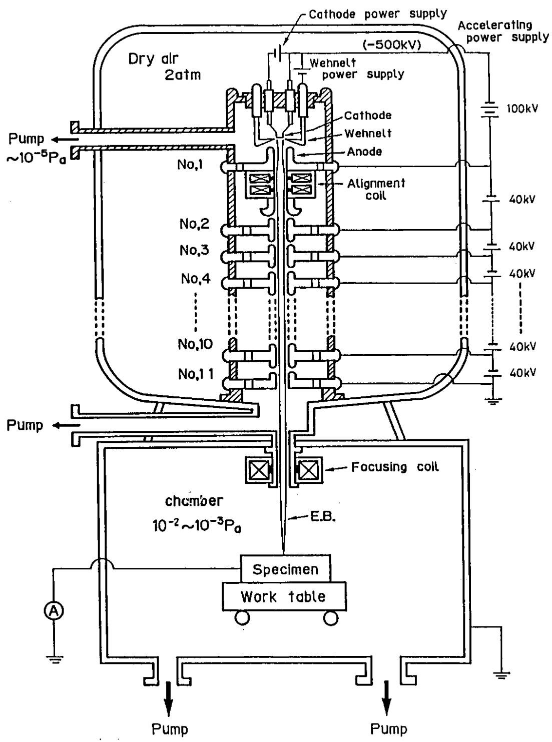

Fig.1 Schematic diagram of 500kV EB heat source.

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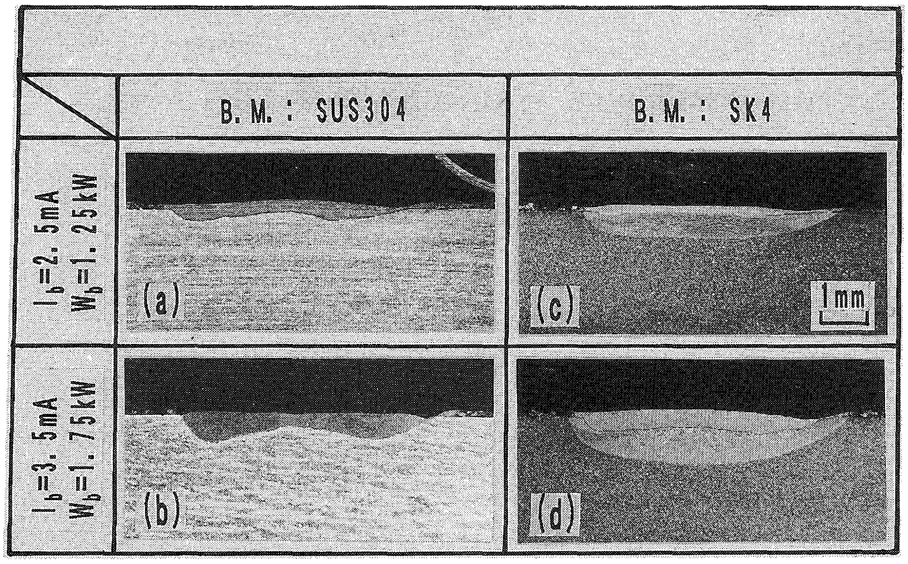
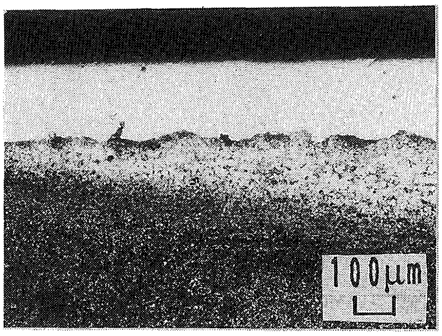


Fig.2 Macro structure of EB melted bead of self-fluxing alloy coatings.(sprayed coatings: 0.2 mm^t)

Ni-Cr alloy coating



Self-fluxing alloy coating

Fig.3 Optical micrographs of cross section of EB melted bead. (sprayed coatings: 0.1 mm^t)

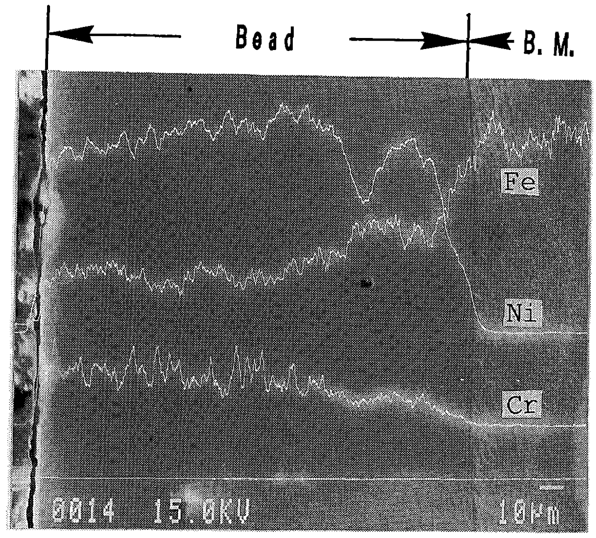


Fig.4 EPMA result of the center of melted bead shown in Fig.2 (c).