OUKA
The University of Osaka
Institutional Knowledge Archive

Title	New Cathode Material for Air-Plasma Cutting
Author(s)	Matsuda, Fukuhisa; Ushio, Masao; Umezu, Sadao
Citation	Transactions of JWRI. 1987, 16(1), p. 215-216
Version Type	VoR
URL	https://doi.org/10.18910/12489
rights	
Note	

The University of Osaka Institutional Knowledge Archive : OUKA

https://ir.library.osaka-u.ac.jp/

The University of Osaka

New Cathode Material for Air-Plasma Cutting†

Fukuhisa MATSUDA*, Masao USHIO** and Sadao UMEZU***

KEY WORDS: (Arc Cutting) (Plasma Cutting) (Thermal Cutting) (Air-Plasma Cutting) (Oxygen Cutting) (Oxide Cathode) (Rhenium) (Yttrium-Oxide)

In recent years, a handy air-plasma torch is widely used for cutting thin steel plate on account of its compactness and low running cost. As shown in **Fig. 1**, the air-plasma cutting technique is very simple and comparatively low current up to 50 A is mainly applied. The cathode is small tip electrode made by Zirconium (Zr) or Hafnium (Hf), tightly mounted in copper sheath. These tip electrode is exposed to oxidizing atmosphere in high temperature, therefore, the durability of the electrode material is a serious problem for this convenient technique. In this paper, it is shown that the new material which is made by sintering of Rhenium (Re) and Yttrium-oxide (Y_2O_3) mixture, has superior durability in air-plasma, compared with Zr and Hf.

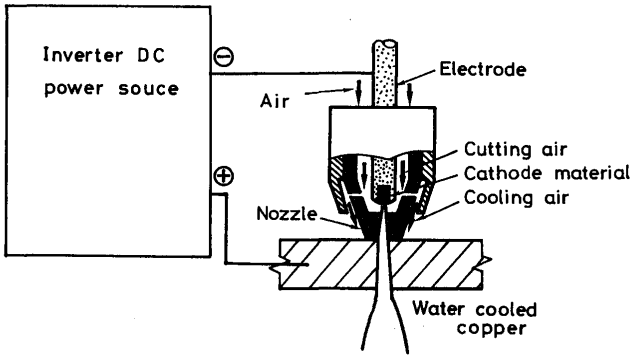

Fig. 1 Schematic drawing of experimental setup.

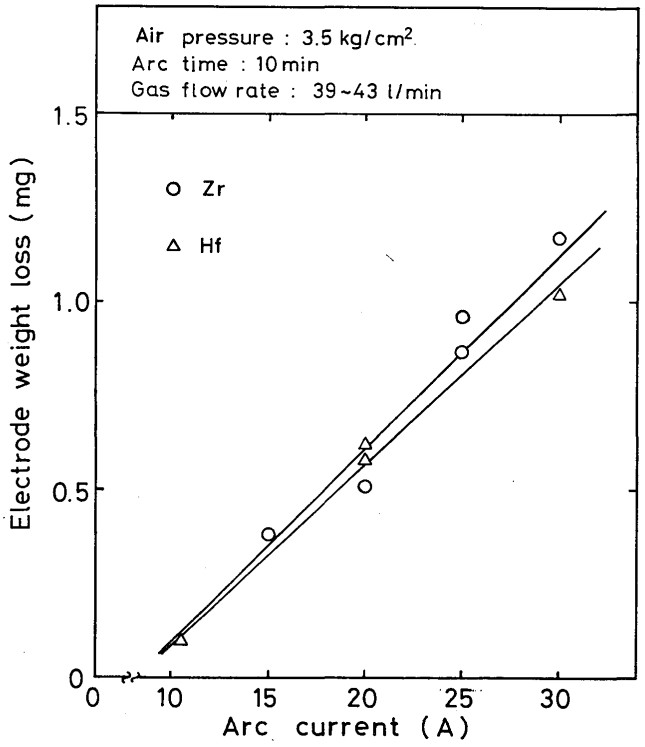

Fig. 2 Relationship between arc current and weight loss of electrode.

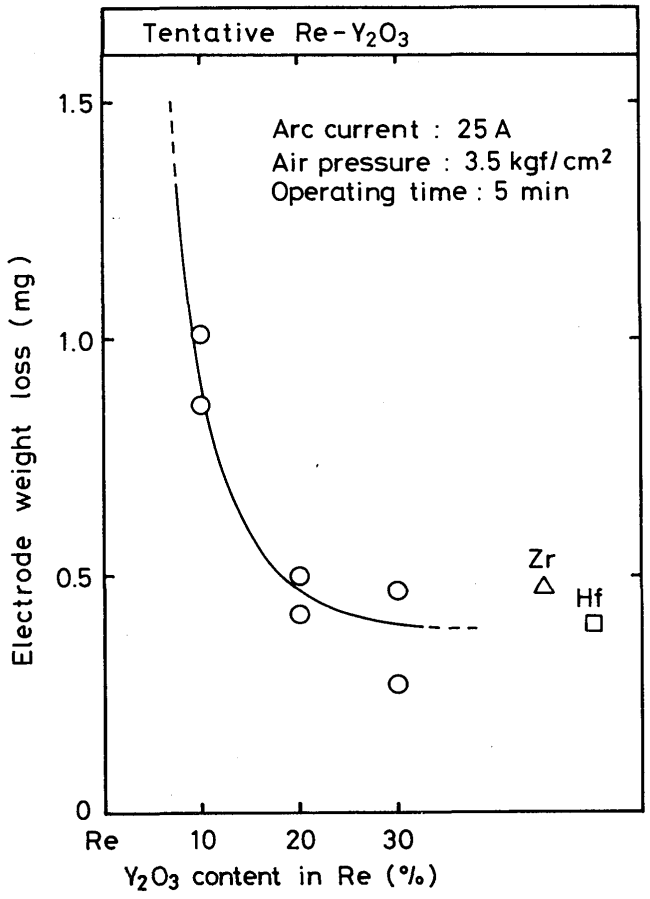

Fig. 3 Relationship between Y_2O_3 content in Re and weight loss of electrode.

* Professor
** Associate Professor
*** Technical Director, Toho Kinzoku Co., Ltd.

Transactions of JWRI is published by Welding Research Institute of Osaka University, Ibaraki, Osaka 567, Japan

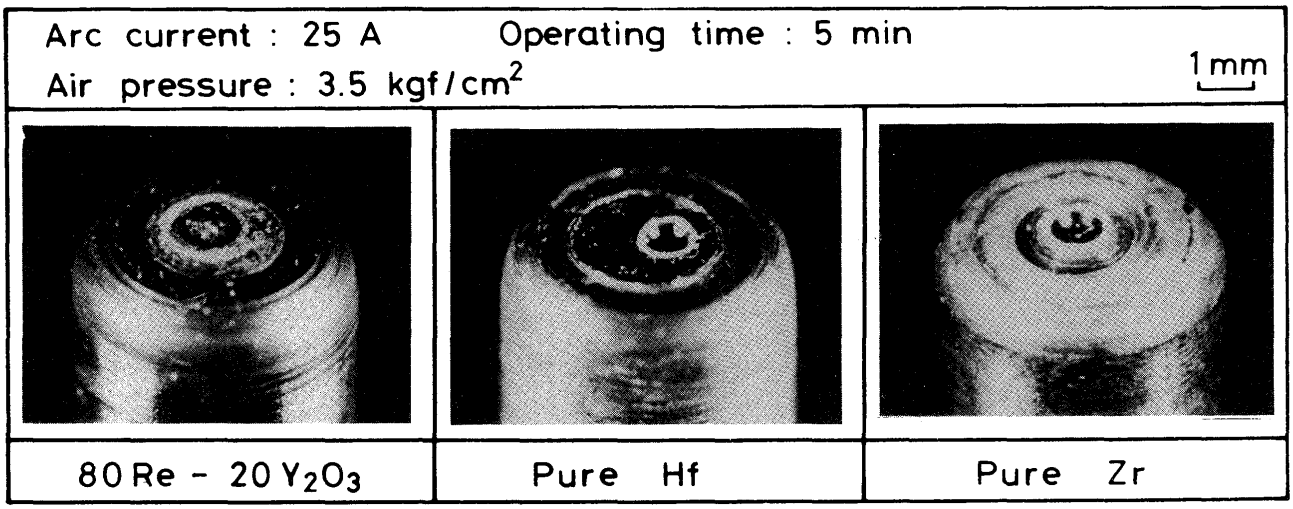

Fig. 4 Phographs of electrode surface after usage.

Table 1 Density of cathode materials

Material	Hf	Zr	Re	Y_2O_3
Density (g/cm^3)	13.1	6.6	21.0	4.8

Figure 1 shows the schematic drawing of experimental setup used for measuring the consumption rate of electrode material due to air-plasma burning. A water cooled copper anode was used instead of thin steel plate.

Figure 2 shows the relationship between arc current and weight loss of tip electrode of Zr and Hf. The weight loss is proportional with the arc current. However due to the difference in density, the volume loss of Zr is about twice as much as one of Hf. Since the volume loss in electrode causes the unstable behavior of arc, the Hf electrode has beter characteristics in durability compared with Zr one.

Figure 3 shows that the electrode loss can be reduced by using the suitably alloyed Re and Y_2O_3. The Re-Y_2O_3 electrode has high density, therefore, the volume loss is very low comparing with Hf electrode.

Figure 4 The photographs in shows the electrode surface consumption after operation at 25A for 5 minutes. The eroded area of Re-Y_2O_3 electrode is rather wide but very shallow, while Hf and Zr electrodes have semispherical cavity after usage.