ANODIC SOLUTION OF HAFNIUM AND ITS CARBIDE

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Hafnium is finding increasing use in the compositions of special alloys such as heat-resistant or refractory types. A knowledge of the anodic behavior of hafnium and its carbide is required in the phase analysis of alloys, electrochemical treatment, and determination of the corrosion properties. The literature gives little information in this field [1-3].

The anodic potentiodynamic curves (120 mV/min) (see Fig. 1) show that hafnium is anodically activated by the same anions as zirconium [4, 5]; the activation potential increases in the same order. The initial stage of solution of hafnium is pitting in type. In an alcohol solution saturated with gaseous HCl, the polarization curve exhibits a limiting current area like that observed for anodic solution of zirconium [6].

In most solutions, hafnium carbide has a wider passivity region than hafnium. However, in $NaNO_3$ and Na_2SO_4 solutions hafnium carbide dissolves faster than hafnium at the same potential. The difference in behavior of the metal and carbide is particularly great in an $NaNO_3$ solution: Hafnium remains passive throughout the potential region investigated (up to 6 V), but its carbide begins to dissolve intensely at a potential of less than 2 V. The difference in anodic behavior of hafnium and its carbide is a basis for their electrochemical separation.

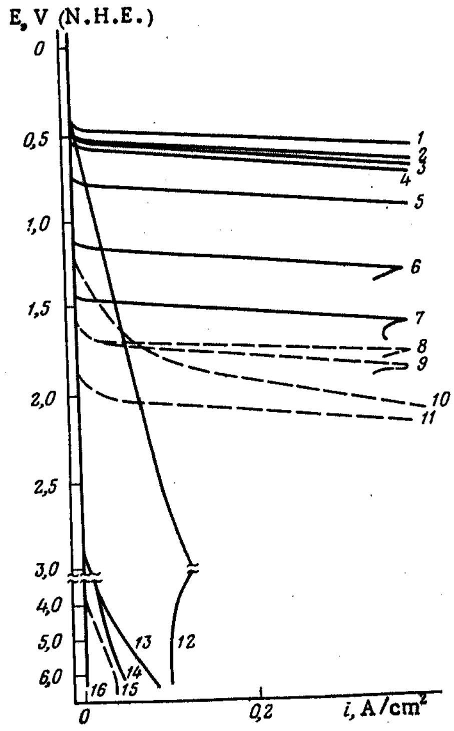

Fig. 1. Potentiodynamic curves of hafnium (——) and hafnium carbide (– – – –) in solutions: 1, 8) HCl; 2) 4 N NaCl; 3) 1 N HCl + 1 N citric acid; 4, 9) NaCl; 5) NaBr; 6) NaI; 7) $NaClO_4$; 10, 12) 5% solution of HCl_{gas} in absolute ethanol; 11) $NaNO_3$; 13) NaOH; 14) NaF; 15) Na_2SO_4; 16) $NaNO_3$, Na_2SO_4, 1 N CH_3COOH; 1 N citric acid, 1 N oxalic acid (coincide). Where the solution concentration is not given, it is 2 g-eq/liter.

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ELECTRODEPOSITION OF BRASS FROM ALKALINE TARTRATE—CITRATE SOLUTIONS

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As shown in [1, 2], deposits containing 74–51% Cu are formed on the cathode from alkaline glycerate brass-plating solutions at $t = 18–20°C$ and $i_c = 0.3–0.2$ A/dm². However, they were not like brass deposits and had a steel-gray color at a thickness of 1–5 μm. Fedot'ev et al. [3] obtained from alkaline tartrate electrolytes copper—zinc deposits of the tombac type with a copper content of 88–91%. Vyacheslavov [4] recommends a tartrate electrolyte for deposition of brass with a Zn content of 30%. However, none of these authors indicates the quality of the deposits obtained.

We have ascertained the feasibility of obtaining yellow brass with a constant copper content of 50–70% within the current density range 0.25–2 A/dm² from alkaline tartrate—glycerate electrolytes.

We investigated the influence of the electrolyte composition and electrolysis conditions on cathodic polarization, the current yield (CY), and the composition and quality of the deposits.

TABLE 1. Dependence of Current Yield, Composition, and Quality of Deposits on Additions of Glycerin and Rochelle Salt (separately) to the Following Solution (mole/liter): $CuSO_4 \cdot 5H_2O$ 0.13, ZnO 0.12, NaOH 2.5 (coating thickness — 10 μm)

Concn., mole liter: Rochelle salt	Concn., mole liter: Glycerin	t, °C	i_c, A/dm²	Copper content of deposit	Current yield	Quality of deposits
–	0,3	20	0,25 0,5–1 1,5 2	95 79–73 57 49	100 100 95 95	Gray pink, no adhesion Greenish gray, no adhesion
–	0.6	20	0,5 1	64 46	96 86	Gray green, peels off
0,5	–	20	0,25 0,5 1–2	85 72 47–42	100 98 95–80	Orange Poor adhesion The same
1,0	–	50	0,5–1 1,5 2,0	95–83 75 52	99–97 96 82	Pink, lustrous Brown Bright green, lustrous
1,5	–	20	0,25 0,5–1 1,5–2	59 40 40	95 90–88 80	Gray green Gray
1,5	–	50	0,25 0,5–0,75 1–2	98 74 36	95 91 86	Pink, lustrous Pink violet Green

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