INVESTIGATION OF THE CHROMIUM-PLATING PROCESS IN A TETRACHROMATE ELECTROLYTE AT HIGH CURRENT DENSITIES

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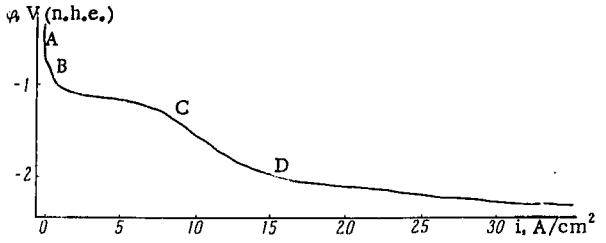

Fig. 1. Potentiodynamic polarization curves obtained on a rotating (6000 rpm) steel disc-type electrode in a tetrachromate electrolyte.

The problem of increasing the capacity of a chromium-plating bath can be solved by an increase in the working current density with strong mixing of the electrolyte.

The present work was done using a cold tetrachromate electrolyte (CrO_3 400, H_2SO_4 3, NaOH 60, sucrose 2 g/liter) which is promising (for example, in the regeneration of worn parts), and a rotating disc-type electrode made of steel 30KhGSNA. When chromium is deposited on steel from this electrolyte without mixing, the current efficiency increases in the range of current densities from 0.1-1 A/cm^2; with a current density greater than 0.8 A/cm^2, the quality of the deposit is noticeably worsened [1].

Potentiodynamic polarization curves were recorded at a rate of 2 V/min, taking account of the ohmic fall of the potential between the rotating disc-type electrode and the tip of the capillary of the mercury sulfate reference electrode [2].

The segment AB of the polarization curve (see Fig. 1) corresponds to the incomplete reduction of hexavalent chromium and passivation of the cathode. On segment BC a dense chromium deposit forms with good adhesion to the steel surface. With a current density of 4.5 A/cm^2, chromium is deposited at a rate of 21 μ/min. The thickness of the deposit was determined in a thin transverse section using an MIM-7 microscope. The microhardness of the chromium deposited, measured in a PMT-3 instrument, was 1100 kg/mm^2. Thus, strong agitation of the electrolyte permits obtaining a high-quality chromium deposit at a high current density.

After holding of the electrode at 10 A/cm^2 (segment CD) there is formed on the surface of the cathode an uneven peeling deposit which is unsuitable for use. At a current density of 35 A/cm^2, metallic chromium is deposited on the cathode. It is possible that this occurs due to the strong alkalization of the layer of electrolyte near the cathode, as a result of the abundant evolution of hydrogen, or with an increase in the NaOH content in the starting solution at lower current densities [1].

LITERATURE CITED

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2. A. D. Davydov, L. L. Knots, V. D. Kashcheev, and V. V. Kushnev, Élektronika Obrabotka Materialov, No. 2, 82 (1969).

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