

The described method is used in the phase analysis of cast irons modified by magnesium and cerium. The analysis of the graphite particles separated from these cast irons and the comparison of results with those obtained by chemical separation showed that chemical processing considerably reduces the degree of modification.

Thus, this method of pneumatic separation gives more objective information on the modifying agent content in graphite. After selecting the correct vacuum this method can be used for separating nonmetallic inclusions contained in cast irons and steels.

USE OF A METHOD OF ANODIC OXIDATION IN STUDYING THE MICROSTRUCTURES OF CERTAIN SUPERCONDUCTING ALLOYS (EXCHANGE OF EXPERIENCE)

N. S. Vorob'eva and Ya. N. Kunakov

Recently reports on the successful use of a method of anodic oxidation for studying the phases in alloys have appeared. The basis of this method is that on the surface of a polished sample as a result of electrochemical oxidation there is formed a thin oxide film ($\sim 0.01 \mu$), the thickness of which depends upon the content of the components in the given phase. This method has been used for niobium-zirconium alloys [1]. Subsequently it has been used for niobium-tin alloys [2-4]. The combination of anodic oxidation with other methods has made it possible [4] to construct the niobium-tin phase diagram. Attempts by a series of authors to choose an electrolyte for vanadium base alloys did not produce positive results.

This work presents results of the use of a method of anodic oxidation to study vanadium base alloys (V-Ga, V-Si, V-Al, V-In) and niobium base alloys (Nb-Sn, Nb-Al, Nb-Ge). This work was carried out on cast samples of the alloys and on samples obtained by a diffusion method.

The anodic etching was carried out in an "Élipovist" electrolytic polishing apparatus and identification of the phases was by microprobe x-ray analysis on an MS-46 "Cames" microanalyzer.

For niobium alloys the electrolyte proposed by Picklesimer [1] was used without substantial changes: 90 ml ethyl alcohol, 30 ml lactic acid (85% $C_3H_5O_3$), 15 ml glycerine, 7.5 ml 85% phosphoric acid, 53 ml distilled water and 3 g citric acid. The etching was carried out with 35-40 V for 30-60 sec.

In all investigated samples the phases formed had the following colors: niobium—light azure, Nb_3Sn —azure or dark azure, Nb_6Sn_5 —dark blue, $NbSn_2$ —lilac, tin—ivory. Other intermediate phases in the Nb-Sn system were not detected. The results obtained agree well with the data of [4, 5]. Using the anodic oxidation method for the alloys Nb-Al, Nb-Ge, and Nb-Ga, stable coloring of all intermediate phases was obtained.

In studying the vanadium alloys V-Ga, V-Al, V-Si, and V-In anodic etching was carried out in an electrolyte made up of: 90 ml ethyl alcohol, 20 ml glycerine, 1.5 ml 85% phosphoric acid, and 20 ml distilled water, and etching was with 35 V for 60-100 sec. Varying the etching voltage in the limits 35-45 V and the time from 30 sec to 3 min did not change the color of the phases. Normally etching was carried out until the vanadium was colored dark blue.

After anodic etching of the V-Ga system the solid solution of gallium in vanadium had a light azure color, V_3Ga —light rose, V_6Ga_5 —lilac, and V_2Ga_5 —yellow-brown.

Our work has shown that anodic etching may be successfully used for research on niobium and vanadium alloys.

LITERATURE CITED

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DETERMINING THE ERROR IN MEASURING THE TEMPERATURE OF METAL IN A BORED HOLE (EXCHANGE OF EXPERIENCE)

V. M. Sheveleb

In determining the heating cycle of a metal the temperature of the latter is frequently measured by thermocouples placed in special drilled holes. Therefore there are errors dependent upon various factors.

The drilled hole alters the temperature field of the metal; the distribution of temperature along its wall differs from the temperature at the same point in the metal in the absence of a hole. Determining this error is difficult. It decreases with a decrease in the diameter of the hole. It is not always possible to accurately place the thermocouple in the center of the hole. The error dependent on this is small since heat in the hole is transmitted primarily by radiation. The flow of radiation to the thermocouple depends little upon its position. To decrease the error resulting from inaccurate placing of the thermocouple its diameter must differ little from the diameter of the hole.

The error dependent upon the flow of heat along the thermocouple may be determined with sufficient accuracy by calculation making the following assumptions (Fig. 1): the thermocouple is placed in the hole with a constant temperature T_0 at a depth z ; the remaining portion of the thermocouple is in a water-cooled tube with a diameter d_t and a temperature of 300°K; the reading of the thermocouple is determined by the temperature at its end $T(z)$; the thermocouple is a single piece; the temperature gradient occurs only along the axis x .

The equation for the temperature field of a rod at $x > 0$ has the form [1]:

$$\frac{d^2T}{dx^2} = -\frac{4}{\lambda d} [\sigma_0(T_0^4 - T^4) + \alpha_K(T_0 - T)], \quad (1)$$

where d and λ are the diameter and the coefficient of thermal conductivity of the thermocouple and $\alpha_K = 2\lambda_b/(D-d)$ is the coefficient of thermal conductivity from the wall through the layer of air. If we introduce the coefficient of radial heat emission, $\alpha_r = 4\sigma_0 T_0^3$, Eq. (1) takes the form

$$\frac{d^2T}{dx^2} = -\frac{4}{\lambda d} \left[\left(\frac{2\lambda_b}{D-d} + 4\sigma_0 T_0^3 \right) (T_0 - T) \right]. \quad (2)$$

In a similar way with $x < 0$ we obtain

$$\frac{d^2T}{dx^2} = +\frac{4}{\lambda d} \alpha_t (T - 300). \quad (3)$$

The border conditions are $x = 0$, $T = T_b$, $q = q_0$, as a result of which $q = -\lambda \, dT/dx$. If we designate

$$\frac{4}{\lambda d} \left(\frac{2\lambda_b}{D-d} + 4\sigma_0 T_0^3 \right) = A^2; \quad \frac{4}{\lambda d} \alpha_t = A_t^2,$$

then the solution of Eqs. (2) and (3) takes the form

$$T = T_0 - (T_0 - T_b) \operatorname{ch}(Ax) + \frac{|q_0|}{\lambda A} \operatorname{sh}(Ax), \quad (4)$$