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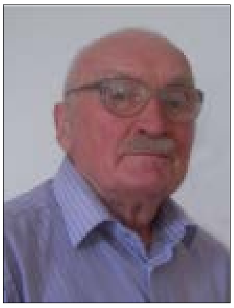
New means for determination of metal and its alloys hardness according to Kotrechko method



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Abstract
New means for determination of metal and its alloys hardness with isotropic and anisotropic behavior are developed. Indenter design, which provides transfer from elastic to plastic deformations when the value of work hardening is smaller, is suggested for isotropic metals. Indenter construction for anisotropic metals allows to determine the hardness taking into account grain flow. Hardness values of isotropic and anisotropic metals and alloys, determined according to Kotrechko method, are more precise as compared with the known ones.
Key words: METAL HARDNESS, ISOTROPY, ANISOTROPY, INDENTER, PLASTIC DEFORMATION

Existing main standard means for determining of metals and alloys hardness [1, 2, 3] do not consider peculiarities of their structure, which influence significantly on the deformation processes during hardness indentation. That is why the means for determination of their hardness should be divided into two types: for isotropic and anisotropic metals.

Determination of hardness of isotropic metals

It is found that hardness indentation into sample is followed by its work hardening therefore resistance to indenter penetration into a sample constantly grows [4]. Thus, depending on geometry of working part of an indenter, with increase, both depths, and deformation zone, hardening size constantly increases, and the received values of metal hardness considerably exceed the valid ones. In this regard the design of an indenter [5] which represents a trihedral pyramid with an angle at top α = 90 ° is developed. Advantage of the offered indenter (fig. 1) lies in the fact that it has sharper top in comparison with the known ones, whereby in the course of tests, the transition from elastic deformations to the plastic ones occurs at much smaller values of sizes of hardening with an identical depth of depression of its tip into metal.

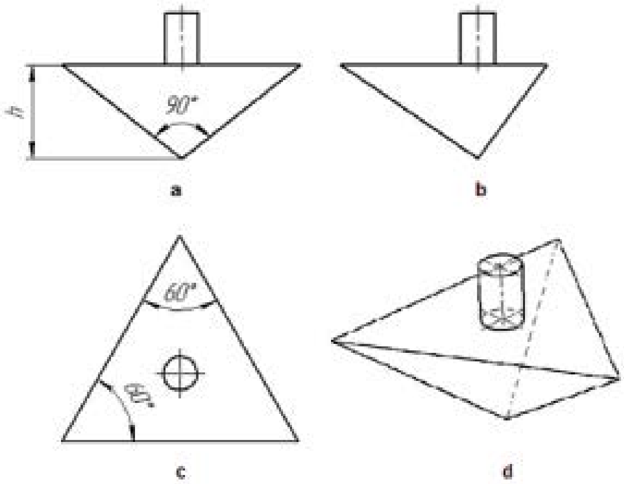

Figure 1. Indenter construction a- front, b- profile, c- horizontal plan, d-general view

Hardness value (HK_m) is calculated according to the formula:

$$HK_m = \frac{P}{4,5h^2} \text{ , N/mm}^2,$$

where P - loading rate, applied to indenter, N; h – depth of hardness indentation into the sample, mm.

Determination of metal and alloys hardness with anisotropy of properties

To determine metals and their alloys with anisotropy of properties [6-7], one may use an indenter made in the form of triangular prism with an angle at the point β and cut off from the butt ends on the angles α sideward of working end with the length L (fig.2).

Such indenter construction allows to measure hardness on the necessary angels towards the directionality of metal structure.

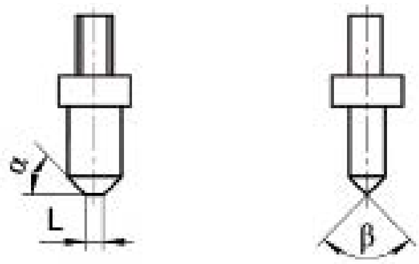

Figure 2. Indenter construction

Hardness value (HKm) is calculated according to the following formula:

$$HK_m = \frac{P}{F} \text{ , N/mm}^2,$$

Where P – loading rate applied to indenter, N; F - impression area, mm^2.

When hardness indentation into the sample the impression area will be like the area of working surface of triangular prism, which is equal to:

$$F = \frac{2h\ [h \cdot \sin(\frac{\beta}{2}) + h \cdot \sin\alpha + L \cdot \cos\alpha]}{\cos\alpha \cdot \cos(\frac{\beta}{2})} \text{ , } mm^2,$$

Where h – is the depth of hardness indentation into the sample, mm; L – is the length of working end, mm; α – is the tilt angle of working area butt end sideward the end; β – is the angle at the point of working area of triangular prism.

At set points of angels α = 45 °, β = 90º and length of working end L= 3 mm, the impression area is:

$F=5.656h^2+8.485h$, mm^2.

Then: $HK_m = \frac{P}{5.656h2 + 8.485h}$, N/mm^2

Conclusions

It was demonstrated that existing standard means of determination of hardness of metals with isotropic properties do not consider the change of their structure in the course of deformation of metal during hardness indentation into sample. For anisotropic metals the hardness should be measured on the certain angle towards the grain flow.

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The Influence of Alloying Elements on Structure Formation, Phase Composition and Properties of Chromium-Manganese Iron in the Cast State

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Abstract
Structures, phase composition, hardness, microhardness of the investigated chromo-manganese cast iron alloys in the cast stay were studied at the present work. It is shown that the hardness and wear resistance of the investigated alloys are determined by the carbon content, degree of alloying matrix and austenite-carbide eutectic and also the number and form parameter eutectic carbide.
Keywords: CHROMO-MANGANESE CAST IRON, AUSTENITE, FERRITE, CEMENTITE, AUSTENITE-CARBIDE EUTECTIC, FORM PARAMETER, DEGREE OF ALLOYING, MICROHARDNESS, HARDNESS, WEAR RESISTANCE