Non-destructive testing of metal ductility by dynamic microindentation

Alexander Kren[1], Alexander Machikhin[2], Valentin Kaloshin[3]

[1]Laboratory of contact-dynamic control methods, Institute of applied physics of the NAS of Belarus, Belarus, [1]Laboratory of acousto-optic spectroscopy, Scientific and Technological Center of Unique Instrumentation, Russia, [1]NDT department, NPO ENERGOMASH named after V.P. Glushko, Russia

Ductility as well as the yield strength and tensile strength is the most important characteristic of metals. It determines their ability to undergo significant plastic deformation. Ductility of metals has great practical importance: thanks to this property, the local stresses are redistributed throughout the volume of material. The evolution of methods for determining ductility is primarily associated with the indentation method. In this paper, we propose to use single impact microindentation method for the evaluation of ductility. SIMI is the most convenient for testing metals, since it allows getting more appropriate ratios for permanent and elastic strain to increase sensitivity of the method to the plastic properties of metals. In the paper we describe a device for carrying out measurements and algorithms for calculating ductility. The results are given of the experiments on the steel samples with different heat treatments, aluminum and copper samples, titanium and alloys. It is shown that the ductility of pure titanium is almost 2 times higher than that for the deformed titanium alloy VT-6. It fully corresponds to the reference information. The ductility of copper is higher than the ductility of its alloy – the brass. Heat treatment of carbon steels significantly influences the ductility: reduces it when the hardness is increased and increases it when the temperature is increased. Experiments carried out on aluminum with varied degrees of rolling showed that its ductility decreases. It is quite natural, because during this kind of treatment the ductility margin decreases. In general, the performed experiments confirmed that application of the method is efficient for nondestructive testing of ductility.