Accepted Manuscript

Title: The Correction of Temperature-Dependent Vickers Hardness of Cemented Carbide Base on the Developed High-Temperature Hardness Tester

Authors: Bicheng Guo, Libin Zhang, Liang Cao, Tao Zhang, Feng Jiang, Lan Yan

PII: S0924-0136(17)30632-5
DOI: https://doi.org/10.1016/j.jmatprotec.2017.12.041
Reference: PROTEC 15578

To appear in: *Journal of Materials Processing Technology*

Received date: 10-8-2017
Revised date: 15-11-2017
Accepted date: 29-12-2017

The Correction of Temperature-Dependent Vickers Hardness of Cemented Carbide Base on the Developed High-Temperature Hardness Tester

GUO Bicheng[1], ZHANG Libin[1], CAO Liang[1], ZHANG Tao[1], JIANG feng[1], YAN Lan[2]

[1] *Institute of Manufacturing Engineering, Huaqiao University, Xiamen 361021, China;*

[2] *College of Mechanical Engineering and Automation, Huaqiao University, Xiamen 361021, China*

Abstract: In this study, a high-temperature hardness tester was developed, and its basic structure, main performance and advantages were introduced. The high-temperature hardness tester has three main advantages: it significantly prevents the oxidation of the sample and the indenter; it does not affect the stiffness of the bearing platform; and ensures the accurate measurement of the relevant image at high temperatures. Then, the Vickers indentation test was carried out using the developed hardness tester. The contact surface of the indenter and the sample was found to be a curved surface, and the height of the middle of the indentation edge was found to be higher than the height of the indentation corner. Therefore, a three-dimensional model of indentation morphology was established, and hardness values at different temperatures were corrected. It was found that the hardness of CTS18D cemented carbide decreased with increasing temperature, and the value decreased by approximately 35% from room temperature to 1,000°C. In addition, at the same temperature, the corrected hardness value was smaller than the measured hardness value. Moreover, the difference value between the measured hardness and the corrected hardness decreased from 3.9% to 3.2% with an increase in temperature from 26°C to 1,000°C.

Keywords: High-temperature hardness; Indentation morphology; Corrected hardness; Cemented carbide

1. Introduction

Hardness is the ability of materials to resist deformation and destruction and is also interpreted as the ability of materials to resist elastic deformation, plastic deformation, press-in or scratch (Westbrook and Peyer, 1973). A material’s elasticity, plasticity, strength and toughness, wear resistance as well as a series of different physical and mechanical properties can be generally presented in terms of hardness; therefore, hardness has been widely used in many production industries or areas. With the development of modern industry, there are more and more parts or structural parts that work in a high-temperature environment, such as engine exhaust valves, pistons, and high-speed bearings; the performance of these metal materials in a high-temperature environment is also in high demand. As mechanical properties of a metal material measured under a normal temperature environment do not fully reflect the actual situation under high temperature, it is very important to simulate the use of the material under working conditions to estimate its high-temperature mechanical properties. Today, high-temperature performance has become an important basis for the design of mechanical parts. High-temperature hardness of the metal and its alloys reflects the ability of materials to resist deformation and wear at high temperatures. Based on the certain relationship between high-temperature hardness and other high-temperature mechanical properties (such as high-temperature strength and durability, creep performance, and high-temperature fatigue properties), high-temperature hardness is considered to be a pre-selection test for other high-temperature tests. In recent years, the instrumented indentation technique has become popular in the field of testing materials’ mechanical properties (Wang et al., 2015). For example, a method was presented to determine the Drucker–Prager parameters of