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Metallic materials - Elastic modulus measurement - Rate-jump method

金属材料 弹性模量测定 率跳跃方法

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Foreword

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Elastic modulus is one of the important mechanical indicators to measure material performance. Accurate measurement of material elastic modulus requires effective technical means. One of the current effective and convenient methods to obtain the elastic modulus of materials is the quasi-static instrumented press-in test based on the Hertz and Oliver-Pharr models. This method is mainly applicable to many hard materials. However, for various types of soft metals or metals at high temperatures, due to obvious Creep/viscoelastic phenomena, elastic modulus test results during quasi-static loading or unloading will be affected by the loading or unloading rate. In addition, move The state load spectrum method is also a common elastic modulus testing method, but the storage and

loss modulus measured by this method are also related to the test platform and test time. related to the loading frequency. These traditional methods are not suitable for various types of soft metals or high-temperature metals. For metallic materials whose deformation is only viscoelastic or elastic, the intrinsic elastic modulus can be measured by this standard. The main purpose of this document is to The rate jump of test force or depth is introduced during the unloading process of overpressure test to measure the intrinsic elastic modulus of the material. Rate jump method for measuring elastic modulus of metallic materials

1 Scope

China's national method for measuring the elastic modulus of metals by the rate-jump technique. Measuring modulus from the initial slope of a tensile curve is the textbook approach and is unreliable in practice: the slope includes the compliance of the machine and the grips, the specimen settles as it is first loaded, and the result is typically low by a margin that varies between laboratories. The rate-jump method avoids all of that by making the measurement during the test rather than at its start. The strain rate is abruptly changed at a point in the plastic region, and the immediate stress response - before the material has time to accommodate the new rate - is elastic, so the modulus follows from the jump. Because it is measured on a specimen already loaded and seated, the machine compliance and the settling have already been taken up, and the result is both more accurate and reproducible.

This document specifies the principles, testing machines, specimens, test procedures, and elastic modulus specifications for testing the intrinsic elastic modulus of metallic materials using the rate jump method. Calculations and test reports. This document is suitable for testing the elastic modulus of metal materials using the instrumented intrusion method under test force control or displacement control, especially when there are Metal materials with obvious creep phenomenon. Other non-metallic solid materials can refer to this document.

2 Normative reference documents

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, the dated quotations For undated referenced documents, only the version corresponding to that date applies to this document; for undated referenced documents, the latest version (including all amendments) applies to this document.

GB/T 10623 Terminology for mechanical properties testing of metal materials

GB/T 21838.1-2019 Instrumented press-in test for hardness and material parameters of metallic materials Part

3 Terms and definitions

The terms and definitions defined in GB/T 10623 and the following apply to this document.

3.1 The inherent elastic modulus of metal materials that is not affected by test conditions such as loading and unloading rates.

3.2 rate jump rate-jump During the press-in process, test for sudden changes in force rate or depth rate after starting to unload.

Note. An example of the preset load process for the push-in test with a content rate jump is shown in Figure 1a).

3.3 Contact stiffnesscontactstiffness The unloading curve is the change rate of the test force F relative to the indentation depth h at the maximum test force (S=dF/dh).

3.4 Se The contact stiffness (3.3) when the specimen creep returns to zero at the maximum test force of the unloading curve.

Note. At this time, the sample material shows a purely elastic response and is not affected by the unloading rate.