WIAP® MEMV®

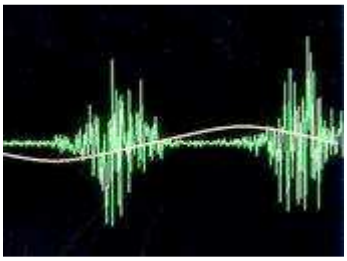
Metall entspannen mit Vibration

REPORT WM MEASURE VOLTAGES 886

Barkhausen noise

1 BARKHAUSEN NOISE

1.1 Barkhausen Noise Analysis



The Barkhausen noise analysis (BNA), also known as magnetoelastic or micromagnetic method based on the principle of inductive measurements of a noise-like signal which is generated when the magnetization of a ferromagnetic component. After the German scientist Professor Heinrich Barkhausen, who explained the principle of this phenomenon as early as 1919, the signal Barkhausen noise is called.

1.2 Barkhausen Noise - the phenomenon

Ferromagnetic materials have small magnetic fields that resemble a model tiny bar magnets and called domains, or Weiss' districts. Each domain is magnetized along a particular crystallographic-graphical preferred direction. The domains are separated from each other by boundaries, which are known as domain walls or domain walls. By alternating magnetic fields, the domain walls move back and forth. Thus, a domain wall can move the domain must zoom in on one side of the wall, while the domain shrinks to the opposite side. The result is a change to the overall magnetization of the part.

When a coil of conductive wire is placed in the vicinity of a ferromagnetic component, while the domain wall moves, the resulting magnetization generates an electrical pulse in the coil. For the first time, the electrical considerations of the movement of the domain wall by Professor Heinrich Barkhausen in 1919 were made. He has proved that the magnetization process, which is characterized by a hysteresis curve, not really runs steadily and continuously, but consists of small, abrupt steps that occur when the magnetic domains move under the applied magnetic field. When all electrical

pulses generated by all of the domain movements are added, a noise-like signal or the Barkhausen noise is generated.

The Barkhausen noise has a power spectrum, which starts at the frequency and magnetization increases for most materials to about 2 MHz. It is attenuated exponentially as a function of the distance to which it has moved in the material. This is mainly caused by the eddy current loss, caused by the propagating electromagnetic fields generated by the domain walls. The extent of damping determines the depth at which information can be recorded (measuring depth). The main factors affecting this depth are

the frequency range of the analyzed Barkhausen noise as well as

the conductivity and permeability of the test material.

The possible measurement depths for practical applications are 0.01 to 1.5 mm, as a rule is only evaluated in the near-surface region to about 0.05 mm depth to the edge zone analysis (grinding burn).

1.3 Barkhausen Noise - the properties

Two important material properties affect mainly the intensity of the Barkhausen noise signal:

One of them is the size of the sign and the distribution of the elastic tensions in the microstructure, which affect the selected domains and closed in the preferential direction of magnetization way. This phenomenon of elastic properties, which cooperate with the structure of the domains and the magnetic properties of the material is called a magneto-elastic interaction. Compressive stresses decrease by magneto-elastic interaction, the intensity of the Barkhausen noise, while the tensile stresses increase the intensity. This applies to materials having positive magnetic anisotropy (iron, most steels, and cobalt, with nickel having a negative magnetic anisotropy, the effect is reversed.) This fact is utilized in the measurement of the intensity of the Barkhausen noise to assess the residual stress state in the edge zone of the material examined. The measurement also determines the direction of the principal stresses.

The second material properties which Barkhausen noise significantly affects the microstructure structure. This effect can be described approximately over the microhardness is the intensity of the noise is reduced in the structure with greater microhardness. So convey Bark-house noise measurements information about microstructural condition of the material examined.

1.4 Barkhausen Noise Analysis - Applications

Many surface treatments such. B. grinding, hard turning, hardening and induction hardening, shot peening cause significant changes in residual stress and microstructure structure of the edge zone which can be characterized by means of Barkhausen noise. The control of hard fine machining (grinding burn test), the main application of the method is Barkhausen. Processes such as creep and fatigue also change the residual stress and microstructure and can be analyzed by means of Barkhausen noise.

Practical applications of the magnetoelastic Barkhausen noise method can be broadly divided into three categories:

Evaluation of residual stresses; as long as the micro-structure-structural variables remain known and constant.

Review of the microstructure; as long as the residual stresses known and remain constant.

Testing of peripheral zones to changes in residual stress and microstructure, which can be affected by heat treatments and machining processes:

* Non-destructive detection of overheating, control of the grinding process

* Monitoring of hard turning operations

* Control of heat treatments

* Non-destructive testing of thermal damage of the substrate by passing chromium plating layers

* Evaluation of the surface residual stress in rolling of steel

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End report WM 886, voltages measured Barkhausen noise
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