

Study on the Magnetic Nonlinear Mixing Frequency Technique and Its Application in Mechanical Properties Assessment

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Assessment of the mechanical properties is of high importance, both for safety and economical in the modern industrial. The majority of conventional non-destructive evaluation techniques are insensitive to the degradation in the microstructure of the metal. However, it is well known that the nonlinearity of magnetic hysteresis in ferromagnetic materials is completely depended on the material microstructure [1] and the mixing frequency method can precisely measure the nonlinear effect [2]. We investigate a new micromagnetic method that exploits the magnetic mixing frequency technique to induce the magnetic nonlinearity. Figure 1 shows a typical example of mixed B-H loop with a set of minor loops superposing on the saturation loop. Then, the minor loss coefficient and the magnetic nonlinear factor are used to characterize the mechanical properties of materials. An experiment result of case harden which assessed by the magnetic nonlinear factor is shown in Figure 2. Also, the magnetic nonlinear mixing frequency method was used to evaluate the fatigue damage of the steel. Compared to the traditional non-destructive evaluation methods, the studied method has an advantage in assessing the subtle changes in microstructural mechanical properties. It has the potential to be used as a non-destructive technique.

Acknowledgement:

This work was supported by the National Key Research and Development Program of China, and the National Natural Science Foundation of China.

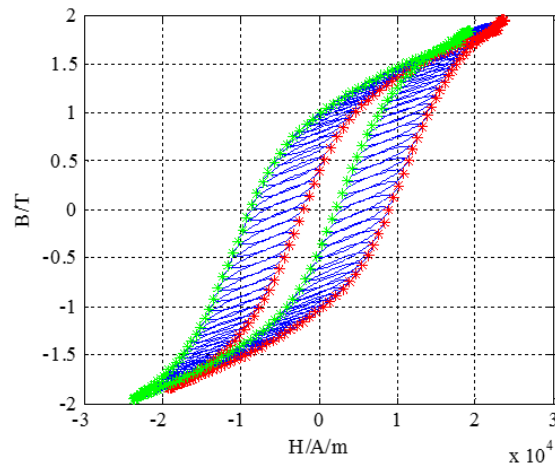


Figure 1. Hysteresis loop of mixing frequency excitation

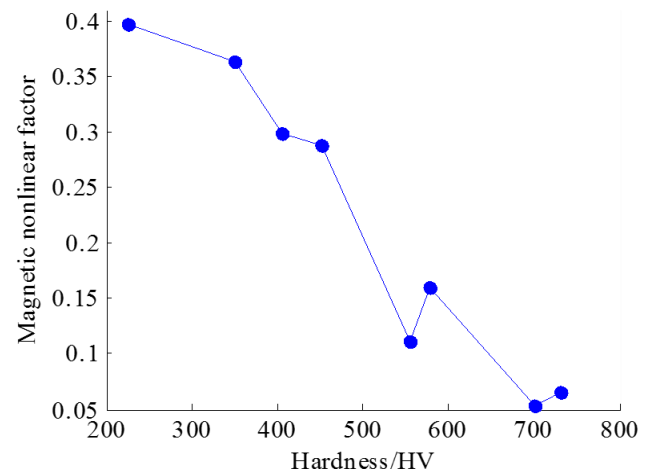


Figure 2. Hardness dependencies of the magnetic nonlinear factors

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