Effect of heat treatment on the internal daming of magnesium alloys

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The gradual accumulation of mechanical energy within a material leads to alterations in its mechanical and physical properties. These changes can degrade material performance, resulting in decreased accuracy of machine tools, the initiation of fatigue cracks, increased noise and vibration in the working environment, modifications to material properties, reduced corrosion resistance, and the deterioration of regulatory devices and sensors. Ultimately, this can cause damage to the entire device. Measuring internal damping provides a means to monitor these structural changes and the various mechanisms involved [1, 2].

Today, there is a significant demand for the efficient use of magnesium-based materials. Magnesium alloys are particularly attractive for various industrial applications due to their specific weight, corrosion resistance, density, and strength. The damping capacity of these alloys is closely related to microstructural defects, including solute atoms, secondary phases, and voids. The interaction between moving dislocations and point defects is a primary mechanism of internal friction in magnesium alloys, meaning precipitates affect the damping capacity and contribute to damping properties. Pure magnesium exhibits very high damping capacity at room temperature due to the easy movement of dislocations. However, an increased concentration of solute atoms such as Al, Ca, and Zn, as well as impurities and precipitates, can restrict dislocation mobility, potentially reducing the friction capacity of magnesium alloys [2, 3].

Internal damping is a highly sensitive method effectively used to investigate structural defects and their mobility. It facilitates the examination of transport processes in materials and phase transformations in the solid state, which are otherwise difficult to detect. The experimental setup includes measurement and control components, along with heating and ultrasonic elements. An ultrasound generator produces a sine wave, which is then amplified and converted into a mechanical wave using a piezoceramic transducer.

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