Temperature dependence of internal damping of austenitic steel in different states

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There is currently considerable interest in the effective use of austenitic steels, especially in areas where high corrosion resistance, toughness and good mechanical properties at elevated and cryogenic temperatures are required. Austenitic steels, due to their face-centered cubic (FCC) lattice, exhibit exceptional plasticity and good damping properties. Their internal damping is closely related to microstructural factors such as the presence of dislocations, interaction with precipitates, work-induced martensitic transformation or dynamic rearrangement of dislocation structures [1, 2].

The primary mechanism of internal damping in austenitic steels is the interaction between moving dislocations and point or linear defects, with slip and mechanical twinning also playing a significant role. Cold working leads to an increase in the density of dislocations, which can temporarily increase the damping capacity of the material, but at the same time it can decrease at higher plastic deformations due to structural stabilization. Alloying elements such as Mn, Ni or Mo affect the stability of the austenite phase and thus indirectly the damping properties. The transformation of austenite to martensite under load can contribute to higher energy dissipation and thus better internal damping under certain conditions. [1, 2].

Internal damping is a very sensitive experimental method that allows for detailed investigation of structural defects and their dynamics in materials. This method provides valuable information about transport phenomena and solid-state phase transformations that are difficult to detect with other techniques. The measuring system consists of control and evaluation components as well as heating and ultrasonic parts. The ultrasonic generator generates a sinusoidal signal, which is then amplified and converted into mechanical waves using a piezoceramic transducer.

The research was supported by the Scientific Grant Agency of the Ministry of Education of Slovak Republic and Slovak Academy of Sciences, No. 1/0461/24, No. 004ŽU-4/2023, No. 016ŽU-4/2023, APVV-20-0427 and project to support young researchers at UNIZA, the ID of project 20422.

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