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Editorial: Nondestructive testing and characterization of solid materials

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Editorial on the Research Topic
Nondestructive testing and characterization of solid materials

In the process of production and long-term service, different forms of defects and microstructure changes are easily produced in solid materials, which leads to the degradation of mechanical and physical properties of materials. Therefore, the development of advanced nondestructive testing and characterization methods and technologies for solid materials is very important for optimizing the production process and ensuring the service safety of materials. In recent years, we have seen the rapid development of the nondestructive testing and characterization techniques for solid materials and structures. However, the recent nondestructive testing techniques are mainly used and studied for detection and evaluation of macro defects in the materials. Nondestructive testing and characterization of micro damage and macro performance of materials are still facing great challenges. This Research Topic is therefore dedicated to the recent advances in research and development of nondestructive testing and characterization of damages, properties and composition of solid materials.

Residual strain makes the internal deformation of metal uneven, dislocation, vacancy and other Crystallographic defect increase, and residual internal stress will be generated in the metal. Dang et al. proposed a new and noncontact method with measuring longitudinal to shear wave velocity ratio by a dual-mode electromagnetic acoustic transducer is proposed for residual strain measurement in a metal structure without knowing its thickness. A dual-mode EMAT that for generating and detecting both L and S waves is developed firstly. Then experimental measurements were conducted on uniaxial tensile specimens with different residual plastic strains using the developed dual mode EMAT. The measurement results verified that there is a linear relationship between residual strain and the LSWVR.

As a noncontact ultrasonic testing method, the application of laser ultrasonic technology to defect detection is being widely studied. Tan et al. proposes a Co-Overlay Software and Hardware method (SAFT-COSH) based on Zynq, which uses

parallelism and pipeline technology on FPGA and can efficiently accelerate DAS-SAFT operations. It can be found that the result obtained by the SAFT-COSH method is similar to the original method. Moreover, the time consumption of the SAFT-COSH system is 1/28 of that of the I9-13900KF CPU used for DAS-SAFT calculation. Finally, it was found by analyzing the time consumption of the DAS-SAFT procedure that the time consumption of SAFT-COSH system is short enough to support realtime 3D defect imaging. Chen et al. presented a new approach for noncontact inspection of defects in milling groove brazed joints of thrust chamber with laser ultrasonic testing method and synthetic aperture focusing technique (SAFT). In the paper, laser ultrasonic testing methods for milling groove brazed joints of thrust chamber was studied with both simulation and experiment. It proved that these techniques enabled clear distinction of defect signals and validated the effectiveness of the detection method.

The circumferential guide wave can effectively evaluate the damage of pipe or the cementation quality between pipe and peripheral medium. Gong et al. solved the circumferential SH wave propagation characteristics of a semi-infinite domain cladding hollow circular pipe, based on the state matrix method and the joint level expansion of Legendre and Laguerre polynomials. The feasibility and accuracy of the proposed theoretical approach is verified by comparing the results with those of the existing literature. The results show that the wave velocity of circumferential SH wave does not change due to the presence or size of the cement bonding defect, but its amplitude increases with the increase of the circumferential angle of the defect.

Šilinskas et al. studied variations in mechanical wood properties of half-sibling genetic families of black alder [*Alnus glutinosa* (L.) Gaertn.]. The results revealed a consistent decrease in almost all measured wood properties from the bottom to the top of the model trees. This vertical variation indicated the importance of considering the location within the tree when assessing wood mechanical properties, which may have implications for wood quality and use.

Author contributions

CP: Writing–original draft, Writing–review and editing. SG: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–review and editing. JW: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–review and editing. WM: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing–review and editing.

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