Spring School for Young Researchers
NEW TRENDS in EXPERIMENTAL MECHANICS - NTEM 1
Zakopane, Poland, May 13-17, 2024

On the Non-standard Experimental Methods for Mechanical Characterization of Conventional and Printed Materials

Z.L. Kowalewski[1*]
** zkowalew@ippt.pan.pl*

[1] Department of Experimental Mechanics, IPPT PAN, ul. Pawińskiego 5B, Warsaw, Poland

The lecture is devoted to three non-standard experimental techniques used for complex characterization of a wide range of materials. Among them one can indicate: yield surface concept; testing of thin sheets under compression within a large range of deformation; dynamic tests for a wide range of strain rates.

In practice, many of engineering materials are not isotropic. In such cases investigation of a yield surface is regarded as one of the most effective methods to study anisotropic properties of materials. Yield loci can be represented in a stress space by the experimental points determined on the basis of stress-strain diagrams for the magnitude of the effective strain assumed as a yield definition. Details of this technique will be discussed based on the experimental data captured for selected materials.

The second non-standard testing method presented in this lecture deals with the mechanical properties characterization of thin sheets. An application of compressive loading usually leads to specimen buckling. To avoid this phenomenon, specialised fixtures are used to support specimen during the test. There are many designs of fixture suitable for monotonic compression. The prototype of an innovative fixture suitable not only for monotonic compression, but also for tension–compression cycles was designed and manufactured by the IPPT research workers. It enables to avoid buckling during compression of specimens made of thin metal sheet. The friction force, which is generated because of a movement of two parts of the fixture, is measured by the special strain gauge system during each test. It allows the elimination of friction force influence on the stress–strain characteristics.

The last type of experimental non-standard techniques presented in this lecture will be devoted to identification of dynamic properties of materials using different kinds of the Split Hopkinson Pressure Bars.

Acknowledgments: The work supported by the National Science Centre through the Grant No 2019/35/B/ST8/03151

[1] V.P. Dubey Ved P., M. Kopeć, M. Łazińska, Z.L. Kowalewski (2023). Yield surface identification of CP-Ti and its evolution reflecting pre-deformation under complex loading, Int. J. of Plast., 167, 1-21.
[2] L. Dietrich, G. Socha, Z.L. Kowalewski (2014). Anti-buckling fixture for large deformation tension-compression cyclic loading of thin metal sheets, Strain Int. J. of Exp. Mech., 50, 174-183.
[3] J.Z. Malinowski, J.R. Klepaczko, Z.L. Kowalewski (2007). Miniaturized compression test at very high strain rates by direct impact, Exp. Mech., 47, 451-463.