Effect of an Ultra-portable Laser Shock Peening System on Copper and Aluminium

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An ultra-portable laser shock processing (LSP) system was deployed to laser shock process copper and aluminum, with the aim of strengthening these materials for EV applications [1]. Aluminum was selected for its wide range of applications and as a useful comparison. Bragg-edge imaging at IMAT mapped residual strains induced by the laser shock processing system. Initial scans on various material compositions, including Copper and Aluminum Alloys, identified the best systems and geometries for imaging. Additionally, residual stress measurements at the ISIS Engin-X facility generated stress profiles, detailing stress variation with depth [2]. These results complemented IMAT strain mapping, enhancing the analysis and understanding of LSP effectiveness. Microstructural data showed grain size reductions of up to 27% in copper and 44% in aluminum, which in turn increased the hardness of copper by 16% and aluminum by 22%. Laser shock processing successfully introduced beneficial residual stresses, highlighting the system's ability to process highly reflective materials like copper. This demonstrates its potential to strengthen copper joints in electric vehicle batteries, enhancing their durability and performance under demanding condition.

[1] Shukla P., (2023), Next-generation Laser Shock Peening: A compact LSP System, The Laser User, Issue 107, Winter 2023. 26 – 27.

[2] Ranggi S. Ramadhan, Daniel Glaser, Hitoshi Soyama, Winfried Kockelmann, Takenao Shinohara, Thilo Pirling, Michael E. Fitzpatrick, Anton S. Tremsin, (2022) Mechanical surface treatment studies by Bragg edge neutron imaging, Acta Materialia, 239, 118259, ISSN 1359-6454.