

METALLURGICAL ASPECTS OF ULTRASONIC WELD OF MULTIWIRE COPPER CABLES

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ABSTRACT

Ultrasonic Metal Welding (USMW) is a solid state welding process applied in many industrial areas, e.g., metal plate welding, electrical wiring, tube sealing and micro welding for electronic applications. USMW is a high productivity process with high quality results when compared with other competing welding processes.

As the process is applied, several physical/chemical phenomena occur, including activation of complex joining mechanisms which co-exist in the same weld.

This work is focused in the study of such phenomena in welded electrical wiring clips made of wired copper cable; involving temperature measuring and respective relation with process main parameters, with use of stop-action techniques to capture the process evolutionary phases and a metallurgical analysis of interface joining, through optical microscopy and SEM.

The lack of knowledge relating USMW is particularly relevant in the relation between the welding process and the equipment's dynamics, as is relevant the influence of normal and shear forces applied to the welding interface and the consequent plastic deformation at the interface.

KEYWORDS: Ultrasonic metal welding, Copper cables, Metallic adhesion, Diffusion.

REFERENCES

- [1] **de Vries, E.**, *Mechanics and Mechanisms of Ultrasonic Metal Welding*, Ohio State University, 2004
- [2] *******, *Welding Handbook 8th Edition* vol.2, *Welding Processes*, American Welding Society, cap. 25, pp. 784-812
- [3] **Cheng, X., Li, X.**, "Investigation of Heat Generation in Ultrasonic Metal Welding using micro sensor arrays", *Journal of Micromechanics and Microengineering* vol.17(2007), 273-282, IOP Publishing, January 2007
- [4] www.amtechultrasonic.com
- [5] ******* *Metals Handbook 2nd Edition* vol. 2, *Properties and Selection: Nonferrous Alloys and Pure Metals*, American Society for Metals, 1985, pp. 239-247, pp. 265-274, pp. 282-292
- [6] ******* *Metals Handbook 9th Edition* vol. 6, *Welding, Brazing, and Soldering*, American Society for Metals, 1985, pp. 746-756
- [7] www.copper.org
- [8] **Harthoorn, J.L.**, *Ultrasonic Metal Welding*, Technische Hogeschool Eindhoven, 1978
- [9] **Jahn, R., Cooper, R., Wilkosz, D.**, "The Effect of Anvil Geometry and Welding Energy on Microstructures in Ultrasonic Spot Welds of AA6111-T4", *Metallurgical and Materials Transactions* vol. 38A, 570- 583, ASM, March 2007
- [10] ******* *Metals Handbook 9th Edition* vol. 9, *Metallography and Microstructures*, American Society for Metals, 1985, pp. 57-69, pp. 139-142, pp. 400-409, pp. 459-464
- [11] *******, *Welding Handbook 8th Edition* vol.3, *Materials and Applications Part 1*, American Welding Society, cap. 3, pp. 163-181
- [12] **Tiley, R.J.D.**, *Understanding Solids The Science of Materials*, Wiley International Edition, pp. 152-154
- [13] **Weronski, A., Hejwowski, T.**, *Thermal Fatigue of Metals*, Marcel Dekker Inc.