The effect of ultrasonic excitation on the electrical properties and microstructure of printed electronic conductive inks [poster]

This item was submitted to Loughborough University's Institutional Repository by the/an author.


**Additional Information:**

- This is a poster presentation

**Metadata Record:** [https://dspace.lboro.ac.uk/2134/17519](https://dspace.lboro.ac.uk/2134/17519)

**Version:** Published

**Rights:** This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: [https://creativecommons.org/licenses/by-nc-nd/4.0/](https://creativecommons.org/licenses/by-nc-nd/4.0/)

Please cite the published version.
The Effect of Ultrasonic Excitation on the Electrical Properties and Microstructure of Printed Electronic Conductive Inks

Alkaios Bournias-Varotsis - Loughborough University

Results in Silver Samples: The results showed an increase in the resistivity of the conductive tracks, which was dependent mainly on the material of the insulating layer.

The resistivity of the tracks on the XV501-T dielectric increased from 368 ± 95 nΩm (n = 19) by approx. 170% compared to the unexcited samples, while on the 8153 dielectric, the resistivity increased from 200 ± 2 nΩm (n = 17) by approx. 75%. The difference between the two dielectrics and the effect of the other variables are illustrated in Fig. 2.

In the case of the 8153 dielectric, issues with short circuits were encountered. This phenomenon enables the embedding of electronic circuits inside the metal parts, such as sensors and interconnections.

Conclusions: The results suggest that printed silver conductive tracks could be used as interconnects in conjunction with UAM, for the fabrication of novel smart metal parts. The increase in resistivity could be taken into account during the design process or possibly avoided by changes in the manufacturing procedure. The material of the insulating layer will be the focus of future work.

More research is required to determine whether ultrasonic excitation can be used as a curing mechanism for copper filled conductive tracks and on the insulating layer were highlighted. Moreover, the potential use of the ultrasonic excitation as a curing mechanism for a copper filled conductive ink was examined.

For the insulating layer, two different dielectric materials were used. Moreover, two different intermediate protective layers were used, two different levels of vibration, the force and the speed of the sonotrode were utilised for the experimentation.

The results showed an increase in insulating layer and silver or copper conductive tracks, using screen printing, on UAM fabricated aluminium substrates. The samples and experimental setup are illustrated in Fig. 1.

Two experiments were conducted: one for silver and one for copper tracks. The silver tracks were thermally cured before the excitation, whereas the copper tracks were dried, but not fired, and as a result they were non-conductive prior to the treatment.

The resistance of the tracks before and after the excitation was measured with a bespoke 4-point probe setup, and their dimensions with an optical 3D surface profiling system, allowing the calculation of their resistivity. Scanning Electron Microscopy with Focused Ion Beam (SEM-FIB) imaging was employed for the examination of the microstructure.