Adhesion of aerosol deposition traces targeted for flexible electronics applications

Adhesion of Aerosol Deposition Traces Targeted for Flexible Electronics Applications

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Introduction

- Emergence of wearable electronics - from medical to consumer products.
- Requirement: To realise conductive traces on flexible substrates.
- Common printing techniques: screen printing and inkjet printing.
- Aerosol deposition (AD)[1] is an emerging potential technology as it offers *room temperature deposition.*
- From literature others have used AD to deposit metal base layers onto flexible substrates. To the authors' best knowledge, there has been no work reported on the deposition of copper onto flexible substrates.
- Copper is an attractive option as it is relatively cheap compared to other metals (eg. silver).

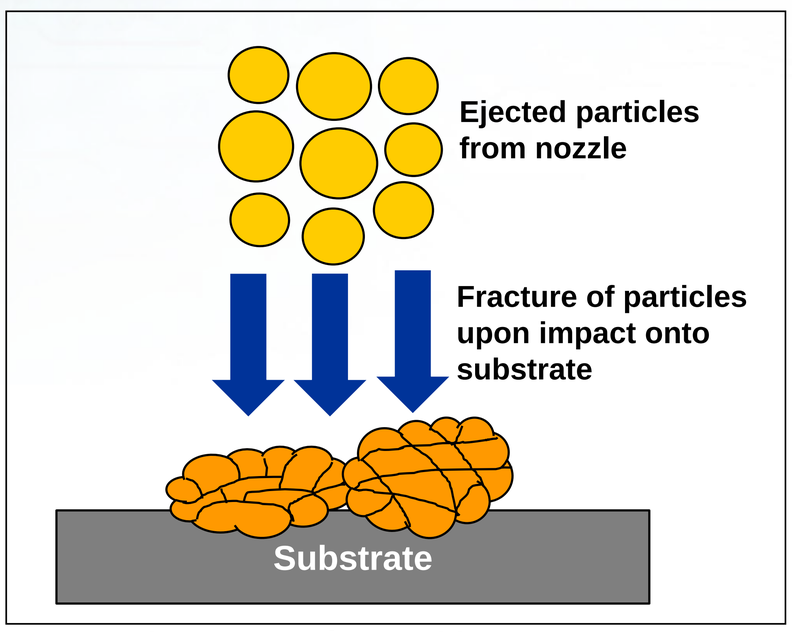


Fig. 1 Aerosol Deposition Process

Goal

- Investigate adhesion of copper (Cu) powders (∅ 2μm) deposited on glass substrates using AD.
- Glass is considered so as to understand the parameters influencing the AD process. Furthermore, if the trace can *adhere to glass slides, it would be able to adhere to other types of substrates*.
- Samples considered:

(a) Cu particles deposited on smooth glass.
(b) Cu particles deposited on roughened glass.
(b) Ceramic particles (Lithium manganese oxide) deposited on glass.

Approach

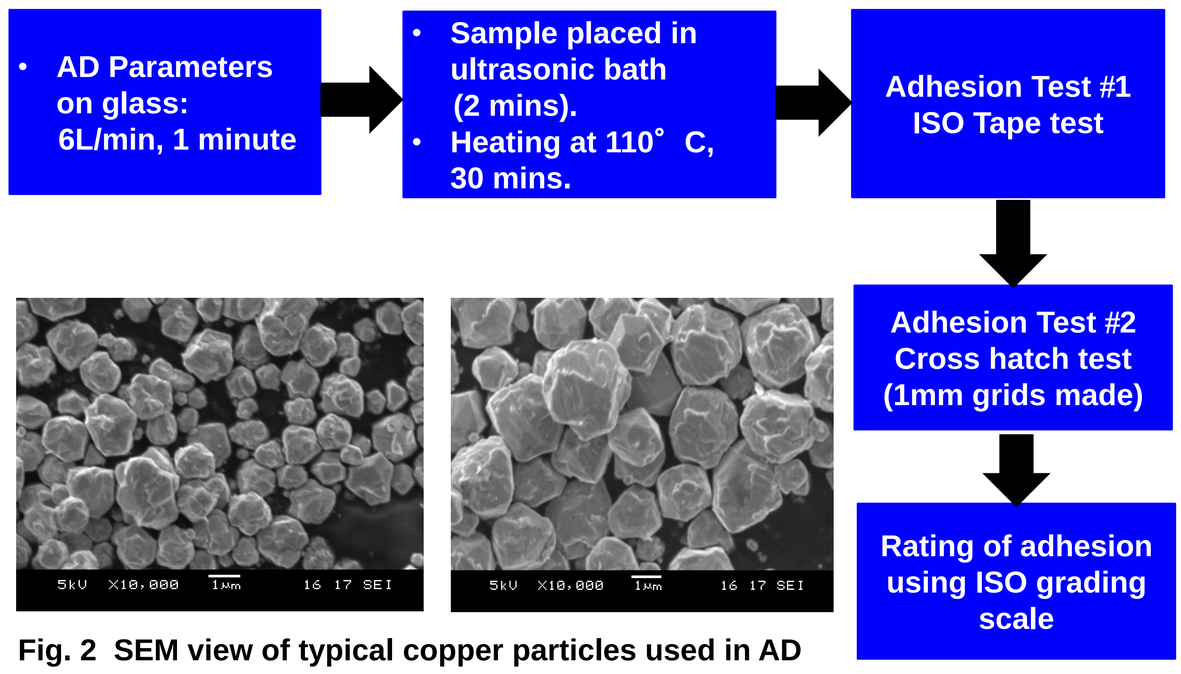
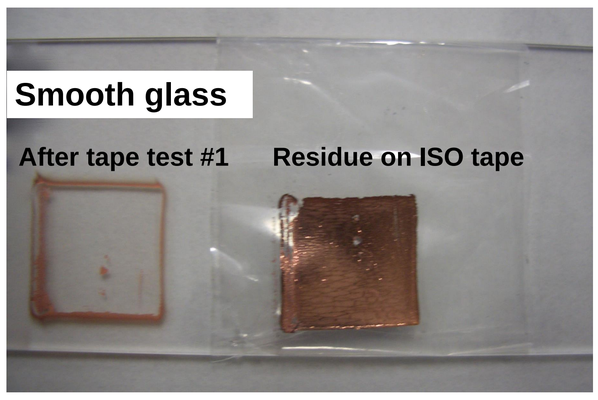


Fig. 2 SEM view of typical copper particles used in AD

Key Results

(a) Smooth glass



Most of the copper film is detached
⇒ minimal adhesion

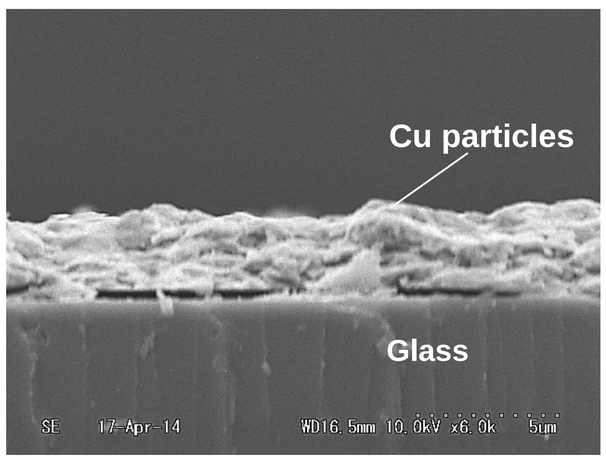
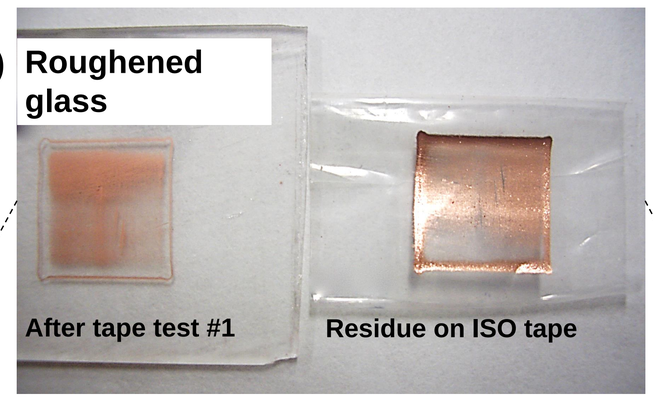


Fig. 7 Delamination of Cu film on smooth glass.

(b) Roughened glass



Adhesion of Cu with glass interface improved, but inhomogeneous anchor layer obtained

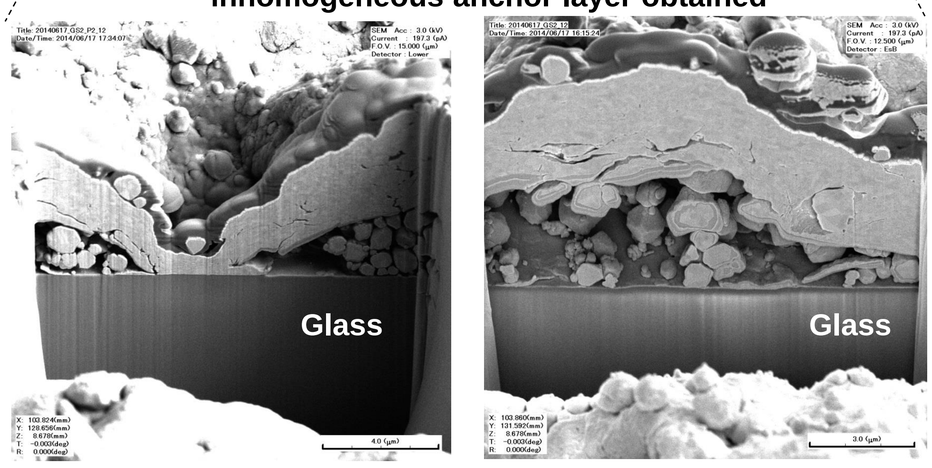
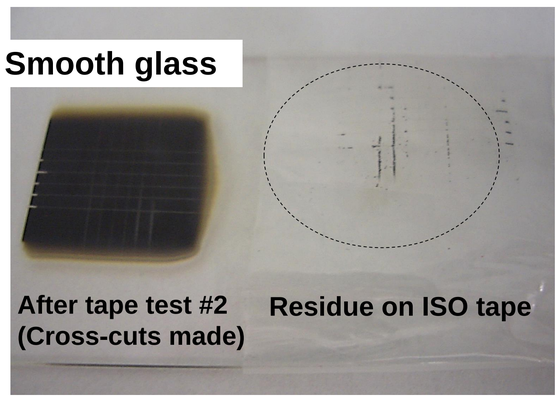


Fig. 8 Cu film on roughened glass with a non-homogeneous anchor layer

(c) Smooth glass



Best adhesion obtained. Adhesion test #2 yields ISO rating of 1

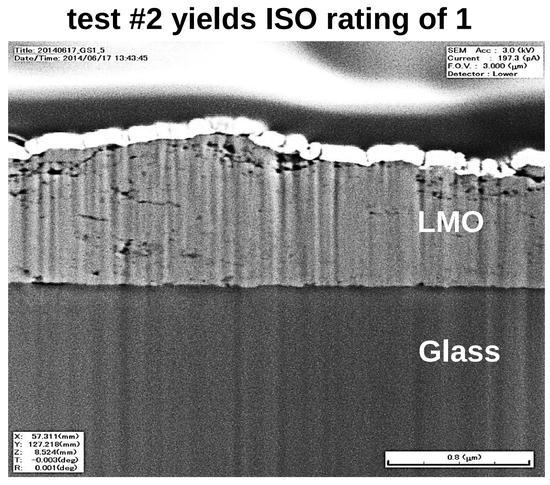


Fig. 9 LMO film with a homogeneous anchor layer

Conclusion

- The adhesion of copper particles deposited onto smooth and roughened glass was investigated. The results were compared to LMO particles deposited on smooth glass.
- The results obtained suggest that the combination of particle hardness and substrate hardness/roughness[2] affects the quality of the base layer deposited.

Future Work

- To improve on the Cu particle-substrate interface adhesion by:

(a) Increasing the impact velocity of the copper particles.
(b) Modifying the substrate surface.

- To compare the adhesion of AD traces with other printed traces.

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