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Adhesion Characterisation of Inkjet Printed Silver Tracks

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Introduction

The ever-growing need for fast prototypes and reduced manufacturing throughput times in the electronics industry has led to worldwide research aimed at developing novel techniques and process chains. Inkjet Printing is a versatile, flexible and relatively simple process that might fit the bill. It falls under Printed Electronics and is an additive fabrication technique. Typically, metal nanoparticle-based inks and polymer-based inks can be used in combination with inkjet printing to fabricate conducting tracks and circuit components (e. g. resistors, capacitors etc.), respectively.

Objective

The main objective of this research is to understand and characterise the adhesion between inkjet printed tracks and substrate materials. The substrate materials used for this purpose are commonly used in the PCB industry e. g. FR-4 (reinforced epoxy). With the knowledge gained from adhesion testing, printing parameters and substrate surface conditioning will then be optimised to yield desirable adhesion properties.

Methodology

On a rigid substrate material, silver nanoparticle-based ink is deposited using a piezoelectric drop-on-demand inkjet printer to print tracks that are subsequently sintered in a conventional oven to impart continuity to the tracks. These tracks are then subjected to Scotch-tape testing, a qualitative test procedure, and Pull-off testing, a quantitative test procedure, to gain insight into the interfacial strength (figure 1). The former test procedure is used only during the parameter optimisation stage where it is required to choose or reject a particular parameter set by qualitatively testing the adhesion of the printed tracks to the substrates. The latter will be used to quantify adhesion of tracks at room and elevated temperatures as well as after cyclic thermal loading of the specimen. Based on the test results, the printing parameters will be optimised. Besides this, a decision on a suitable substrate conditioning method prior to printing and substrate temperature during printing will be arrived at (figure 2).

References

ASTM D4541

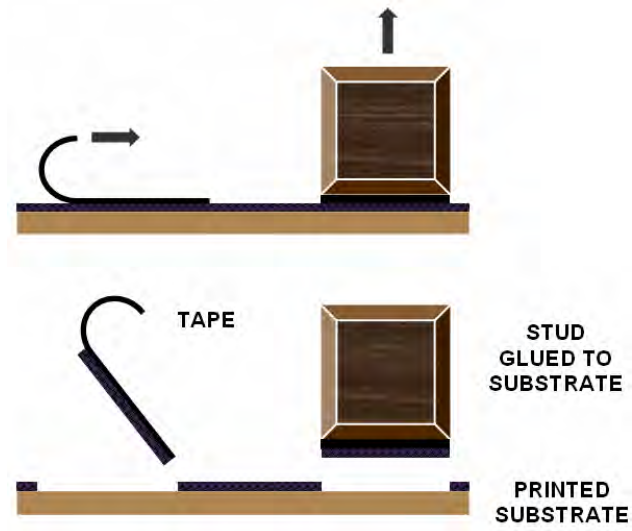


Figure 1: Scotch-tape test and Pull-off test procedures

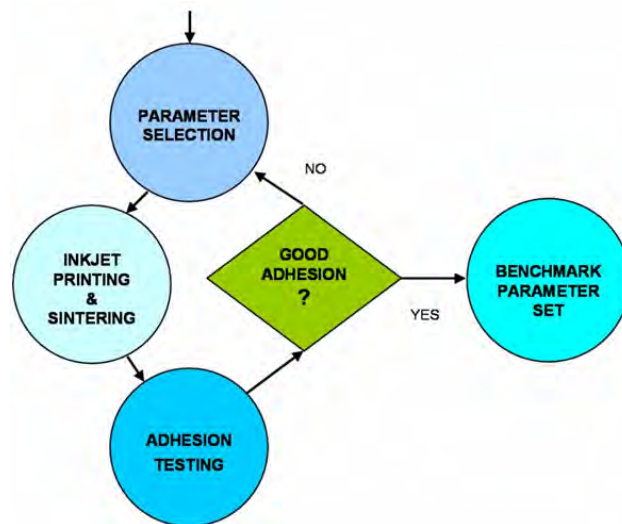


Figure 2: Test methodology