The Use of Inkjet to Create Direct Write Conductive Features

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Abstract

The process of inkjet dispensing metal particulate dispersions to obtain conductive features is an intriguing prospect and reflects an interesting dichotomy for inkjet technology. The ink must be reliable to the extreme, whilst at the same time, contain the maximum possible solids loading of metal particles to create high conductivity, typically less than 10 milliohms per square. It is not straightforward to jet metal dispersions as most conductive materials have densities of up to10g/cm, leading to rapid settling rates in low viscosity fluids for anything other than nano-sized particles. In addition, such high densities create problems in depositing sufficient active materials. For example, an ink with a 35% w/w solids loading ink can contain only 3.5% of active material by volume, significantly reducing the ability to deposit thick metallic layers. Finally, in order to achieve high inkjet reliability and conductivity, the metal particles require a highly effective dispersant which needs to be volatilised during a post heating treatment process.

In contrast, this paper describes an alternative novel approach to allow the direct inkjet dispensing of a range of metals onto non porous materials. The technology uses UV cure based inks and relies on creating a cured "honeycomb" open structure and depositing metal in bulk around strands of a three dimensional UV polymeric network. The process is flexible and capable of being used in many different industrial configurations, including as an inline high speed digital web. This approach achieves high inkjet reliability, high conductivity and the flexibility of tuning a wide range of metal layer and line thicknesses without the need for any post treatment process. Examples of the use of inkjet to create a range of metal tracks using both piezo and thermal inkjet printheads will be presented. The electronic functional performance and properties will be illustrated using a range of different key features such as printing directly to chips or components, printing small features down to less than ten microns and creating highly conductive tracks.

Author Biography

Dr Bentley joined Xennia in January 1999 and is now Senior Scientist responsible for a number of multi-disciplinary projects. Dr Bentley has been involved with all forms of ink jet technology through developing a wide range of products for a variety of "difficult" applications. He has been responsible for a number of break-through ink jet inventions and is the inventor of the current direct metal printing technology.

Before joining Xennia he completed a PhD at Sheffield University working on the synthesis and characterisation of liquid crystalline electroluminescent polymers for use in polarised display applications and graduated from Loughborough University of Technology in 1995 with a BSc Honours degree in Chemistry with Polymer Science Technology.