

Distinguished Speaker Seminar

A Case Study on Sustaining a Technology-Based Economy in the US: *Continuous Inkjet Printing of 3-D Electric Circuits*

Michael R. Lovell

Associate Dean for Research
School of Engineering
University of Pittsburgh

ABSTRACT

Globalization is driving equilibrium changes in standards of living, economic performance, and education. As the US adapts to globalization, it must overcome the unrelenting challenges posed by offshoring, the shift of intellectual and technology leadership overseas, and the development and growth of foreign economies. In the wake of these growing uncertainties, it is clear that innovation is the key for sustaining a technology-based economy in the US. This is especially true as increased global competition forces engineering processes and technologies to be faster, more efficient, and cheaper than existing methods. As an example of such a process, the present investigation introduces an innovative technique for manufacturing 3-D electronic products. The research specifically focuses on the electronics industry where the US is globally behind in terms of manufacturing efficiency.

The general hypothesis for our research is that existing technology can be implemented in new ways to produce better and more innovative products. In this light, our new process utilizes continuous ink-jet (CIJ) printing technology and novel metallic inks to produce 3-D conductive traces on a wide range of substrates including a product's base structure. The major advantages of the proposed process are that it 1) provides a fast and cost-effective method for applying conductive lines on existing products, 2) eliminates the 2-D shape restrictions of current electronic components (i.e. printed circuit boards) 3) increases product design freedom by allowing conductive traces in any orientation of 3-D space, 4) eliminates the need for labor intensive subassemblies, and 5) allows a new design flow where CAD software can be integrated directly into the manufacturing processes of electronic products.

In developing the new process, several technological hurdles were overcome - the greatest being the formulation and production of new conductive inks. In our research, two patented particle-free conductive ink solutions were developed that were low in cost, were easy to deposit, adhered well to the substrate, and showed exceptional electrical properties. The first ink was an aqueous based solution that consisted of silver nitrate with additives and had an electrical resistivity only 2.9 times that of bulk silver. The second ink solution was a metallo-organic decomposition (MOD) that exhibited a close-packed silver crystal microstructure and had a resistivity very close to bulk silver. When utilized in our specially designed Continuous Inkjet (CIJ) printing system, both ink solutions produced high-quality conductive traces in three-dimensions. Such a finding demonstrates that existing technology can be used to fundamentally change the design and production of electronic components.

Thursday, January 31, 2008
206 Furnas Hall
11:00 am – 12:15 pm

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