Reliability of 3D Printed Electronics

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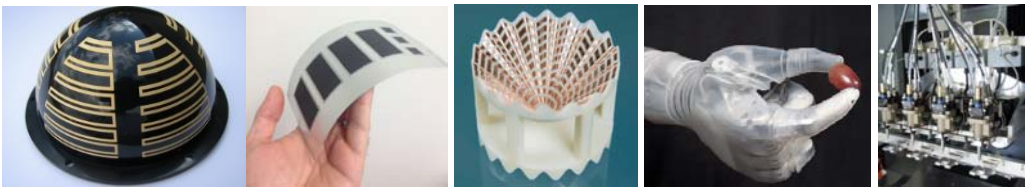

Abstract: An important future direction for evolution of microelectronics requires the ability to integrate electronics within curvilinear and deformable substrates. Important examples include: (i) wearable electronics integrated into flexible/stretchable clothing, footwear and headwear; (ii) medical electronics integrated into soft deformable prosthetics or smart bandages; and (iii) electronics that can be packaged into curvilinear 3D host structures, such as antenna embedded within radomes/hulls/canopies of transportation vehicles. This trend represents a radical departure from most current electronics form factors that are meant for mostly planar and semi-rigid substrates.

Additive manufacturing (AM) methods, sometimes termed as 3D printing methods, offer great promise for such new 3D curvilinear deformable form factors that have not been feasible with conventional subtractive lithographic manufacturing methods. These new architectures will require embedded/integrated components/substrates that are thin and flexible and often of non-uniform thickness, resulting in non-planar interfaces. In addition, novel material sets will be needed for printable polymeric and ceramic dielectrics, printable conductive inks and printable support/scaffold base structures. Processes will include sintering and curing, resulting in radically different microstructures, nonstandard manufacturing stresses and new defect families. The net result is novel reliability challenges, not all of which are fully understood yet.

This presentation will discuss new opportunities for Additive Manufacturing in Electronic systems, summarize national research initiatives, UMD capabilities, highlight a few of the detailed challenges that have to be solved by the manufacturing community and explore novel reliability challenges.

Presenter: Dr. Dasgupta is an expert in degradation and failure physics of complex electronics architectures and has been collaborating with FHE research teams to examine the ability of printed 3D electronics to survive typical life cycles. He has published extensively in the area of reliability of advanced electronics and microsystems under combined thermal, mechanical, electrical and chemical stress environments. He has offered advanced instruction on these topics for the past 25 years, in academic and industrial settings, and has won several major awards in this area. He is a past Chair of ASME Electronics and Photonics Division and is an ASME Fellow.