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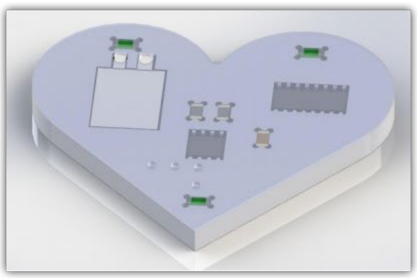
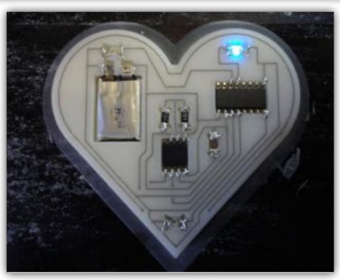
USF and nScrypt Show How 3D Printed Circuit Structures Can Replace PCBs

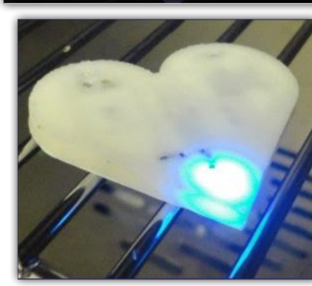
In an SMTA white paper recently posted by Circuitnet, Orlando, Florida-based nScrypt , its research arm Sciperio, and researchers at the University of South Florida described a roadmap for using 3D printing to move from Printed Circuit Boards (PCBs), which are standard in electronics packaging designs today, to Printed Circuit Structures (PCSs). The authors describe how PCSs solve the problem of incorporating an increasing number of active and passive electronic components and antennas into increasingly smaller and complex electronics packages. Combining 3D printing and printed electronics, the team designed a unique structural build with printed electronics materials as part of the structure, or housing. The team predicts that PCSs will eventually replace PCBs as electronics are reshaped and reformed, and become part of the structure of electronic devices.

Because printed electronics require thin lines and 3D printing typically produces comparatively thick lines, the team found that using nScrypt's microdispensing and material extrusion tool heads, which operate without tool changes on nScrypt's multi-process, multi-material 3D printing platform, could print both electronic layers and continuous conductive lines AND the structure of the device. For example, the team used material extrusion (sometimes called FDM or FFF) to print a smart phone housing, then microdispensed an inverted-F-antenna (IFA) on the inside surface of the housing. The team used nScrypt's SmartPump™ microdispensing tool head to print the antenna vertically up the side of the housing. Specifically, the IFA was printed in the XZ plane, not the XY plane. The tool head's pentip was placed about 70 µm away from the inner wall of the housing and the IFA was then printed vertically, using DuPont CB028 silver.

The team also fully 3D printed an arbitrary design for an electronic device with three alternately flashing LEDs powered by a LiPo cell. The photo below shows the device covered and uncovered. The circuit was printed (embedded) into the housing of the device, which itself was 3D printed with ABS. Voids in the ABS securely held the electronic components, which could be inserted with nScrypt's pick-and-place tool head. Interconnections were EPO-TEK H20e silver epoxy microdispensed with the nScrypt SmartPump™. All materials were cured automatically *in situ*. An overcoat of 3D printed ABS incorporated functional vias and provided structural protection.







The team members were: Kenneth Church, Xudong Chen, Paul Deffenbaugh, Casey Perkowski, and Sam LeBlanc of nScrypt, Eduardo Rojas of the University of South Florida, and Thomas Weller, formerly of the University of South Florida and now a professor at Oregon State University and head of the school of EECS. At the time of the project, Ken Church was also a professor at the University of Texas at El Paso.

The white paper can be found here.

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