Engineering Conferences International
ECI Digital Archives

Composites at Lake Louise (CALL 2015) Proceedings

Fall 11-11-2015

Printed and structurally integrated electronics for air force applications

Daniel Berrigan
United States Air Force Research Laboratory, john.berrigan.1@us.af.mil

Benjamin Leever
United States Air Force Research Laboratory

Michael Durstock
United States Air Force Research Laboratory

Follow this and additional works at: http://dc.engconfintl.org/composites_all

Part of the Materials Science and Engineering Commons

Recommended Citation

Daniel Berrigan, Benjamin Leever, and Michael Durstock, "Printed and structurally integrated electronics for air force applications" in "Composites at Lake Louise (CALL 2015)", Dr. Jim Smay, Oklahoma State University, USA Eds, ECI Symposium Series, (2016). http://dc.engconfintl.org/composites_all/89

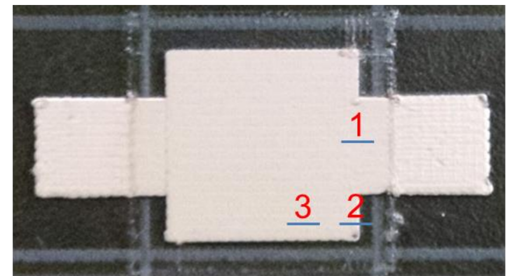
This Conference Proceeding is brought to you for free and open access by the Proceedings at ECI Digital Archives. It has been accepted for inclusion in Composites at Lake Louise (CALL 2015) by an authorized administrator of ECI Digital Archives. For more information, please contact franco@bepress.com.

Printed and Structurally Integrated Electronics for Air Force Applications

J. Daniel Berrigan, United States Air Force Research Laboratory
john.berrigan.1@us.af.mil
James O. Hardin, UES, Inc.
Ming Shao, UES, Inc.
Benjamin J. Leever, United States Air Force Research Laboratory
Michael F. Durstock, United States Air Force Research Laboratory

Key Words: Flexible Electronics, Additive Manufacturing, 3D Printing, Printed Electronics

Both printed and flexible electronic systems promise to integrate functional devices into new form factors (e.g., structures or clothing) and environments. Of particular interest are the mechanically harsh environmental conditions to which military systems are sometimes exposed, which can be quite severe (i.e., upward of 100,000 G peak acceleration within 0.1 ms), and commercial off-the-shelf components are not designed to maintain functionality under such rugged conditions. The overarching aim of this project is to leverage the unique ability of additive manufacturing to digitally control materials properties in three dimensions to create multifunctional systems whose structure is ruggedized for mechanically these harsh environments. Specifically, the work presented here will discuss the initial efforts to develop and characterize the electronic and mechanical properties of dielectric (i.e., PMMA and PVDF-HFP) and conductive Ag inks compatible with filamentary deposition. These inks have been 3D printed into parallel plate capacitors in a continuous process and electrically characterized. We will discuss the path planning necessary to ensure the dielectric breakdown strength of such printed dielectrics was comparable to spin- and tape cast films, and initial high-G drop tower testing results. These results are the first step towards stretchable passive electrical devices for high-G applications and their integration into structures for embedded sensing. Finally, this work will be tied into the broader interests of the Air Force Research Laboratory by highlighting external efforts to develop both structurally integrated and flexible hybrid electronics.



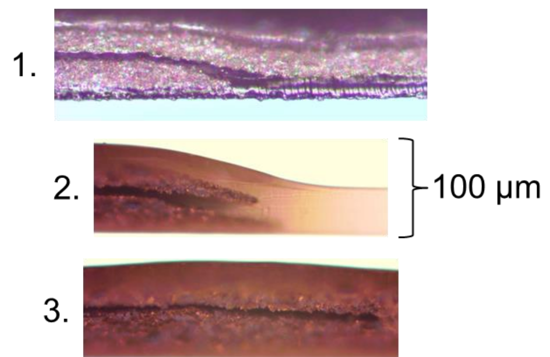


Figure 1 – Optical images illustrating a 3D printed flexible capacitor composed of PVDF-HFPalong with corresponding cross-sectional images showing the parallel plate structure.