

Cold Sintering of Functional Materials

IEEE Distinguished Lecture

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Cold Sintering involves a transient phase that permits the densification of particulate materials at low temperatures 300 °C and below. Sintering at such low temperature offers so many new opportunities. It permits the integration of metastable materials that would typically decompose at high temperatures. So cold sinter enables a platform for better unification of material science. Now ceramics, metal and polymers can be processed under a common platform in one step processes. With controlling the forming process new nanocomposites can be fabricated. Polymers, gels and nanoparticulates can be dispersed, interconnected and sintered in the grain boundaries of a ceramic matrix phase. With the ability to sinter metal phases, multilayer devices can be co-sintered with electrodes made from metals such as Al, Ag, Fe and Cu. With appropriate binder selection, polypropylene carbonate and its de-binding at 130 °C we can remove organic binders and leave metals and other more stable polymers within the layers that then can be co-sintered under the cold sintering process and form unique combinations of materials in multilayers. This talk will cover some of the fundamentals of cold sintering, as well as some new examples of this technology across different material systems, ranging from ferroelectrics, semiconductors, and battery materials.

Clive A. Randall is Professor of Materials Science and Engineering and Director of Materials Research Institute at The Pennsylvania State University. He has a B.Sc. (Honors) in Physics from University of East Anglia, UK (1983), and a Ph.D. in Experimental Physics from University of Essex, UK (1987). He was Director for the Center for Dielectric Studies 1997-2013, and Co-Director of the Center for Dielectrics and Piezoelectrics 2013-2015 (now Technical Advisor). Interests include discovery, processing, material physics, and compositional design of functional materials. Among his awards are Fellow of the American Ceramic Society, Academician of World Academy of Ceramics, IEEE Distinguished Lecturer, and honorary Fellow of the European Ceramic Society. Prof. Randall has a Google h-factor of 76 and over 20,000 citations.

