

Luke S. Walker PhD

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Synopsis

Thermal processing is the most critical step in the development of material systems with desirable properties, in addition to playing a large role in production costs and industrial throughput. The strong relation between thermal processing and material properties makes it a powerful tool in designing material systems, but its critical nature can cause significant damage if not performed properly. From a background in ceramic processing and high temperature furnace processing a synergistic approach can be developed to form materials systems with desired features for industrial applications. Experience with advanced techniques of thermal processing at industrial scales such as Spark Plasma Sintering, Hot Pressing, Vacuum Furnaces, Hydrogen Gas Furnaces and High Temperature Graphite Furnace processing allows for the utilization of the proper tool for the desired resulting material product.

Education

Doctor of Philosophy Materials Science and Engineering
The University of Arizona – Tucson, Arizona
May 2012

Master of Science Materials Science and Engineering
The University of Arizona – Tucson, Arizona
December 2010

Bachelor of Science Ceramic Engineering
Missouri University of Science and Technology (Missouri S&T) – Rolla, Missouri
December 2007

Professional Experience

Current Position Heraeus GMSI

R&D Manager

- Lean R&D techniques to allow for rapid development of novel products.
- Development of production materials utilizing advanced ceramic materials.
- Customer interface to select and optimize material systems for demanding applications.
- Leading engineering teams for material and process development.

October 2015-December 2017 Thermal Technology LLC

Chief Technology Officer

- Customer interface to develop customized furnace equipment for specialized industrial applications.
- Leading engineering teams for mechanical and electrical system design for new applications.
- Furnace equipment product development to optimize performance and cost using new technologies.
- Material system design and selection for demanding applications involving extreme environments.
- Operation of industrial research laboratory for development of customer products and process.
- Collaboration with customers to achieve their material development goals and requirements.

March 2014-October 2015 Thermal Technology LLC

R&D Manager

- Equipment design and development to advance furnace product lines.

- Material design and selection for demanding applications involving high temperatures and stress.
- Management of the onsite R&D laboratory for internal and external customer development work.

May 2012 to February 2014 The University of Arizona – Materials Science and Engineering

Postdoctoral Research Associate

- Direct current sintering and finite element modeling of large scale and near net shape ceramic parts.
- Fundamental investigations of the direct current sintering process for process control and uniformity.
- Characterization of material properties at high temperature and in extreme environments.
- Proposal writing for federal and state level funding of materials research and development.

Materials Research Experience

- Extreme high purity Si_3N_4 ceramics for low loss microwave window applications.
- High strength and toughness Si_3N_4 -Graphene/nanotube composites.
- Nano-grain microstructure alpha Si_3N_4 for extreme wear resistance.
- Sintering of ZrB_2 , HfB_2 and composites for ultra high temperature aerospace vehicles.
- Diffusion bonding of metals and high temperature ceramic systems with 100% strength retention.
- Sol-Gel synthesis of HfB_2 and ZrB_2 powder systems.
- Oxidation mechanisms and kinetics of advanced carbon systems for ablative re-entry applications.
- Direct Current Sintering/Field Assisted Sintering/Spark Plasma Sintering and diffusion bonding.
- Ceramic matrix composites for aerospace applications.
- High temperature metal systems: Rhenium, Tantalum, Molybdenum, Tungsten.
- Oxide systems for transparent and translucent window systems: Spinel, Al_2O_3 , $\text{MgO}/\text{Y}_2\text{O}_3$.
- Thermochemical generation of renewable fuels using ceramic substrates.

Publications

L.S. Walker, E.L. Corral, “Self-Generating High-Temperature Oxidation-Resistant Glass-Ceramic Coatings for C–C Composites Using UHTCs” *J. Am. Ceramics Society* 97 [9] 2014

L.S. Walker, E.L. Corral, “Structural Influence on the Thermal Conversion of Self-Catalyzed $\text{HfB}_2/\text{ZrB}_2$ Sol–Gel Precursors by Rapid Ultrasonication of Oxychloride Hydrates” *J. Am. Ceramics Society* 97 [2] 2014

L.S. Walker, W.R. Pinc, E.L. Corral, “Powder Processing Effects on the Rapid Low-Temperature Densification of ZrB_2 – SiC Ultra-High Temperature Ceramic Composites Using Spark Plasma Sintering” *J. Am. Ceramics Society* 95 [1] 2012

L.S. Walker, J.E. Miller, G.E. Hilmas, L.R. Evans, E.L. Corral, “Coextrusion of Zirconia–Iron Oxide Honeycomb Substrates for Solar-Based Thermochemical Generation of Carbon Monoxide for Renewable Fuels” *Am. Chemical Society:Energy & Fuels* 26 [1] 2012

L.S. Walker, V.R. Marotto, M.A. Rafiee, N. Koratkar, E.L. Corral, “Toughening in Graphene Ceramic Composites” *Am. Chemical Society:NANO* 5 [4] 2011

E.L. Corral, **L.S. Walker**, “Improved ablation resistance of C-C composites using zirconium diboride and boron carbide” *J. Euro. Ceramics Society* 30 [11] 2010

W.R. Pinc, M. Di Prima, **L.S. Walker**, Z.N. Wing, E.L. Corral, “Spark Plasma Joining of ZrB_2 – SiC Composites Using Zirconium–Boron Reactive Filler Layers” *J. Am. Ceramics Society* 94 [11] 2011

S.L. Natividad, V.R. Marotto, **L.S. Walker**, D. Pham, W.R. Pinc, E.L. Corral, “Tape Casting Thin, Continuous, Homogenous, and Flexible Tapes of ZrB_2 ” *J. Am. Ceramics Society* 94 [9] 2011

M.D. Clark, **L.S. Walker**, V.G. Hadjiev, V. Khabashesku, E.L. Corral, R. Krishnamoorti, “Fast Sol–Gel Preparation of Silicon Carbide–Silicon Oxycarbide Nanocomposites” *J. Am. Ceramics Society* 94 [12] 2011

M.D. Clark, **L.S. Walker**, V.G. Hadjiev, V. Khabashesku, E.L. Corral, R. Krishnamoorti, “Polymer Precursor-Based Preparation of Carbon Nanotube–Silicon Carbide Nanocomposites” *J. Am. Ceramics Society* 95 [1] 2012

Patents

Erica L. Corral, **Luke S. Walker**, Victoria R. Marotto, Mohammad A. Rafiee, Nikhil Koratkar, “Graphene-Reinforced Ceramic Composites and Uses Therefor” US20130184143-A1