Revolutionary Advances in Large-Scale Manufacturing Polymer Derived Ceramic Structures in Quantities of One
Discussion Points

• Brief History of the Company

• Evolution of UMS Technology

• Overview of Technology
Brief History of the Company

• Invention
• Business
• Partnering
Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

3 Inventors Bulk Ceramic

Arnold Hill United Materials and Systems, Inc

Dr. Weifeng Fei United Materials and Systems, Inc

Dr. Linan An, UCF Advanced Materials Processing & Analysis Center (AMPAC) University of Central Florida

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

3 Inventors

Hybrid Bulk Ceramic

Arnold Hill  United Materials and Systems, Inc
Dr. Weifeng Fei  United Materials and Systems, Inc
Mark Tellam, P.E.  United Materials and Systems, Inc

“Methods For Synthesizing Bulk, Composite and Hybrid Structures From Polymeric Ceramic Precursors as well as other Polymeric Substances and Compounds” U.S. Patent Application Serial No. 12/584,213
The core business of UMS is the development and application of bulk ceramic and combinations of PDC which build upon bulk ceramic.

UMS is engaged in:

• Researching Derivatives and Applications of PDC’s and Bulk PDC;
• Developing Intellectual Property (IP) for Derivatives and Applications identified;
• Conducting Verification Studies for such Derivatives and Applications;
• Developing Turn-Key Production Solutions for such Derivatives and Applications;
• Working with End Users to Validate these Production Solutions to their Applications;
• Manufacturing Hybrid PDC Components
Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

Arnold Hill President
Fengxia Ma PI, NASA Phase 1

Brief History of the Company / Business

United Materials and Systems, Inc June 2010
Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

Business Development with FLHTCC

Florida High Tech Corridor Council (UCF, USF, UFL)
Provided External Matching Grant

Florida Manufacturing Extension Partnership (FMEP)
(NIST_DOC)

Brief History of the Company / Partnering

United Materials and Systems, Inc June 2010
UCF Technology Characterization

UCF Advanced Materials Processing & Analysis Center (AMPAC) (UCF College of Engineering)

- AES/SAM Physical Electronics 600
- EPMA JEOL 733 Super Probe
- PicoSPM (STM, AFM) Molecular Imaging
- SEM Hitachi 3500N
- SIMS CAMECA IMS-3F Ion Microscope
- SIMS PHI Adept 1010 Dynamic System
- RBS Geneal IONIX 1.7 MU Tandetron
- ESCA (XPS) Physical Electronics 5400
- FIB FEI 200 TEM
- TEM FEI Tecnai F30
- XRD - Rigaku D-MaxB
- XRD II - Rigaku D-MaxB
- Zeiss ULTRA-55 FEG SEM

http://www.ampac.ucf.edu/default.asp
Brief History of the Technology

• Coating Applications
• Nano Technology Extensions
• Bulk Material Applications
• Hybrid Bulk Material Applications
Brief History of the Technology

- 1986  Hercules
- 1990  Dow Corning
- 1995  Lanxide
- 1996  Commodore
- 2001  KiON
- 2007  UMS

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

Ref: Ceramic matrix composites: fiber reinforced ceramics and their applications edited by Walter Krenkel
Coating Applications

Clear
Anti Corrosion
Gas Barrier
Easy to Clean
High Temperature

Corrosion protection coatings

Ref: Clariant

Brief History of the Technology

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

United Materials and Systems, Inc June 2010
Coating Applications

Application of PZane formulations

Wiping

Roll coating

Spray coating

Dip coating

Spin coating

Ref: Clariant
Nano Technology Extensions

Lithographically Defined Structures & Components

Micro Fluidics

Ref: UCF AMPAC

Brief History of the Technology

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

United Materials and Systems, Inc
June 2010
‘Meso’ Process Discussion

Polymer Derived Ceramic Precursors = Fetal Ceramic

Working with Fluid, Curing with Heat and/or Light
Subject to: Critical Gas Diffusion Path Length & Differential Strain
Ceramic Matrix Composite Applications

Circuit Boards

Disk Brakes

Ref: Starfire Systems

Brief History of the Technology

United Materials and Systems, Inc
June 2010
Subject to: Polymer Impregnation and Pyrolysis

Brief History of the Technology

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

United Materials and Systems, Inc June 2010

Ref: Ceramic matrix composites: fiber reinforced ceramics and their applications edited by Walter Krenkel
Evolution of UMS Technology... the First and Only Bulk PDC Material

Ref: United Materials and Systems
The First and Only Bulk Material Process Flow
The First and Only Bulk Material Principle
NASA Deliverable

• Process Overview

• Green Body Development

• Ceramic Mirror Substrate
25 cm Scaffold
Pick a PreCursors, any PreCursors
Green Body Development

- Green Body *(Ceramic Children)*
- Machining *is performed to yield near net shape, while plastic*
- No Tooling
- Low Energy Consumption
Green Body Development
Green Body Development
Green Body Development
From Green Body to Ceramic
Ceramic Mirror Substrate

• Unique Adult Ceramic Processed to 800-1000 (deg C)
• Less Energy Consumed than with Sintering
• Grinding Polishing Accomplished Relatively Easily
• Metalizing Exploring Feasibility and Options
Ceramic Mirrors

15 cm Mirror Substrate
Ceramic Mirrors

Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

Deliverable for NASA

United Materials and Systems, Inc June 2010
Revolutionary Advances in Manufacturing Polymer Derived Ceramic Structures

Retort 1

Retort 4 for 25cm GB

Retort 3

Evolution of UMS Technology

United Materials and Systems, Inc June 2010
Post Phase One SBIR Development Activities
Hybrid PDC Component Development

Young Green Body Cross Sections

Post P1 NASA Activity
United Materials and Systems, Inc June 2010
Hybrid PDC Component Development

Teenager Green Body Cross Sections
Hybrid PDC Component Development

Monolithic Bulk Solid with Fully Dense Surface Cross Sections

Post P1 NASA Activity

United Materials and Systems, Inc June 2010
Machinability Process Capability Studies
Machined Green Body Properties
More Parts, More Applications, Predictive Modeling
More Equipment, More Partners, New Location

Post P1 NASA Activity

United Materials and Systems, Inc June 2010
Overview of Technology

- No Tooling
- Low Volume, High Mix Manufacturing Model
  - Low Total Cost To Part
  - Monolithic Structure
  - Isotropic Structural Properties
  - Homogeneous Material
  - Component Region Appropriate Density
  - Pre-Ceramic Alloying => Ceramic Alloying
United Materials & Systems Inc

ahill@ceramicore.com
mtellam@ceramicore.com

PO Box 536055
Orlando, FL 32853-6055
321.662.4199

Contact UMS for your ‘Rapid Manufactured Ceramic’ Solution