Phase I SBIR/STTR "Lightweight Materials For Mirrors and Aerospace Applications"

July 31.2007
Mirror Tech Days

Advanced Powder Solutions, Inc
Randall Echols, Dean Baker
Houston Texas
(661) 373-1729
sales@apowders.com

Northwestern University
M. P. Ulmer, S. Vaynman, M. E. Graham
Evanston, Illinois
(847) 491-5633

Overview

- APS Information
- Technical Approach
- APS Materials Results
- Applications
- Northwestern Replication
- Phase II Direction

MTD
July 31,2007

Company Overview

- Overview
  - Small Disadvantaged Business
  - Name, Location: Advanced Powder Solutions, TX, MD
  - Company Structure: S-Corp , Since 2005
  - Associations: UC Davis, IBM, Bell Helicopter, NASA- Marshall, & Goddard, Ohio State, Northwestern, and many others

- Company

  Current products and services: metal coated micro-sized particles for electronics, PM parts, turbine, wear resistant materials, thermal spray, aerospace & military markets.

- Current Technical Discussion focused on 2 Main SBIR programs

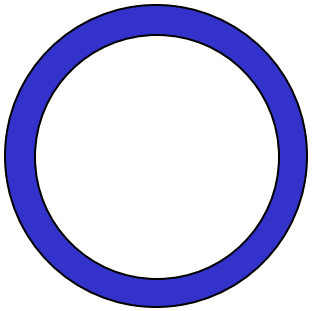
  - *Beryllium replacement material (Phase I MDA- Dr. Doug Deason),\ HQ0006-06-C7402*
  - *Lightweight Mirrors (NASA Phase I- Dr. David Content)* **NNG06LA41C**

MTD
July 31,2007

PM APPROACH/TECHNOLOGY ADVANTAGE

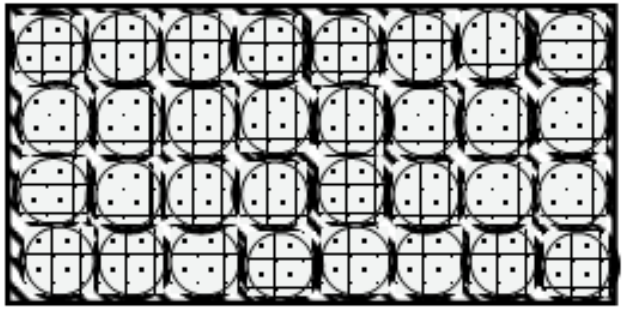
APS has demonstrated that improved control of chemistry at the atomic and powder level enhances the performance of existing compositions and enable the formation of new and improved compositions. The control of the composition and surface reactivity at the atomic level enables designers to tailor the properties for the final material.

Encapsulated Powder



Control Chemistry
Surface Reactions

Particles Can be Ceramic or Metal- Wide variety of Compositions or Coatings can be metal, ceramic, or combinations.



Consolidated Nano-Composite
Control Phases, segregation, composition and chemical interactions during processing

Final Composite tailorable properties: Thermal Conductivity. Electrical, Modulus, Expansion, Shielding, Tensile , or other desirable changes.

MTD
July 31,2007

INITIAL MIRROR TECHNICAL APPROAH

Simultaneous Manufacture

Fabricate Substrate

Fabricate Mirror

Finished Product

SUBSTRATE DEVELOPMENT

Multiple Base Systems- at least 12 different compositions/variations

Fabricate Test Coupons

Machine Coupons

Characterization Testing

Downselect to Component- subscale, mirrors 3”, 6” 12”

Examples of Samples

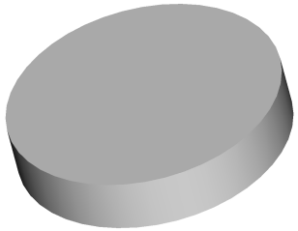
System 3

Standard Phase I Tests (Room Temperature)

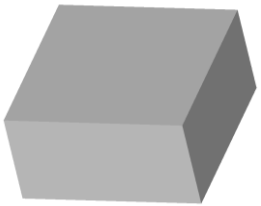
Phase I Test Specimens

Modulus Sample
1.5 “ (d), .1” thick

Thermal Diffusivity Sample
0.5 “ (d), .1” thick



Specific Heat Sample
1” x 1” x 0.1”



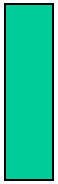
Tensile

ASTM Short

Sample

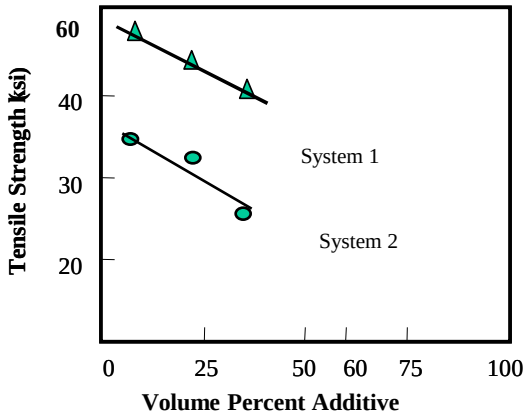
1” x 3 “x.25”

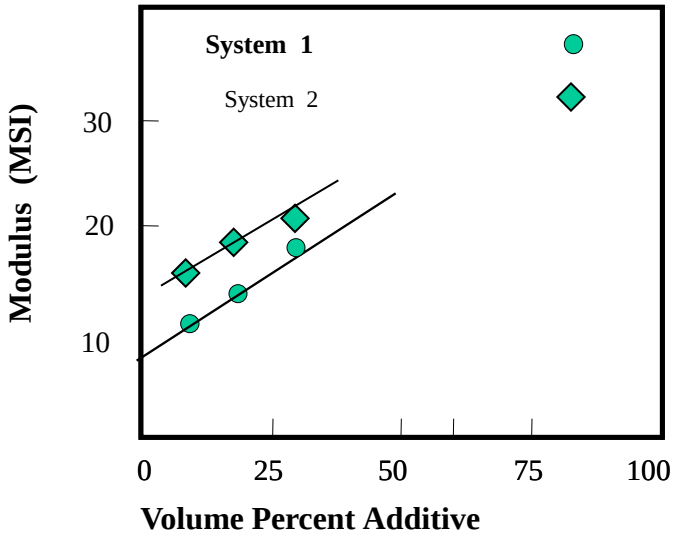
Thermal Expansion
.2”x.2” x 2.0”

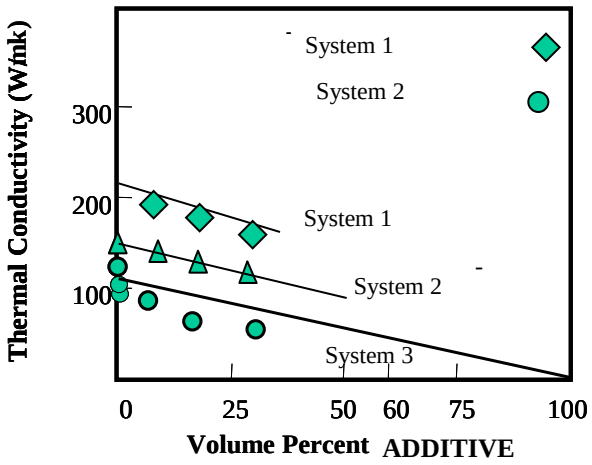


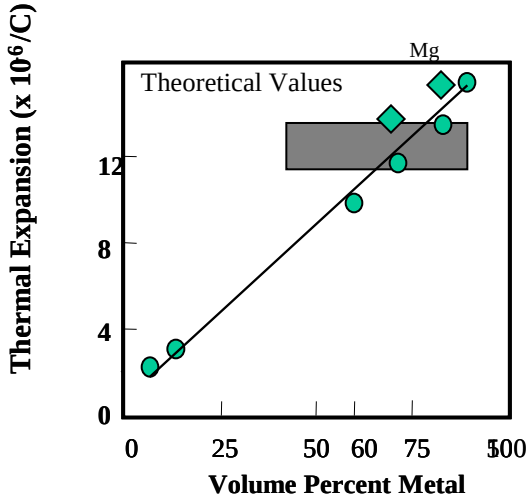
MTD
July 31,2007

Two Example Systems



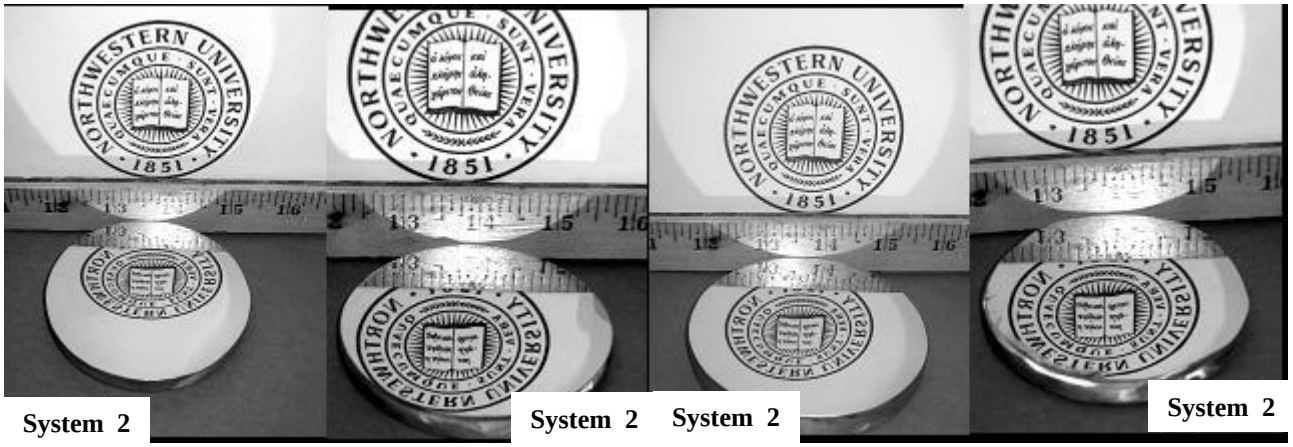






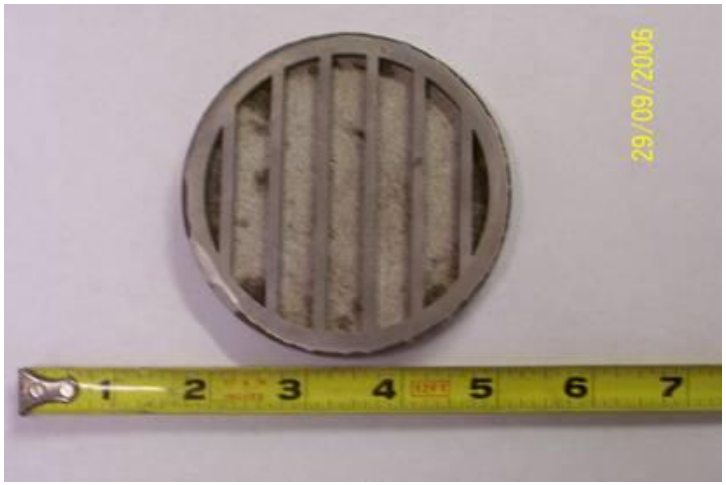
MTD
July 31,2007

Mirror Examples



System 2 | System 2 | System 2 | System 2

EDM Parts



Lightweight Part with Machined Back

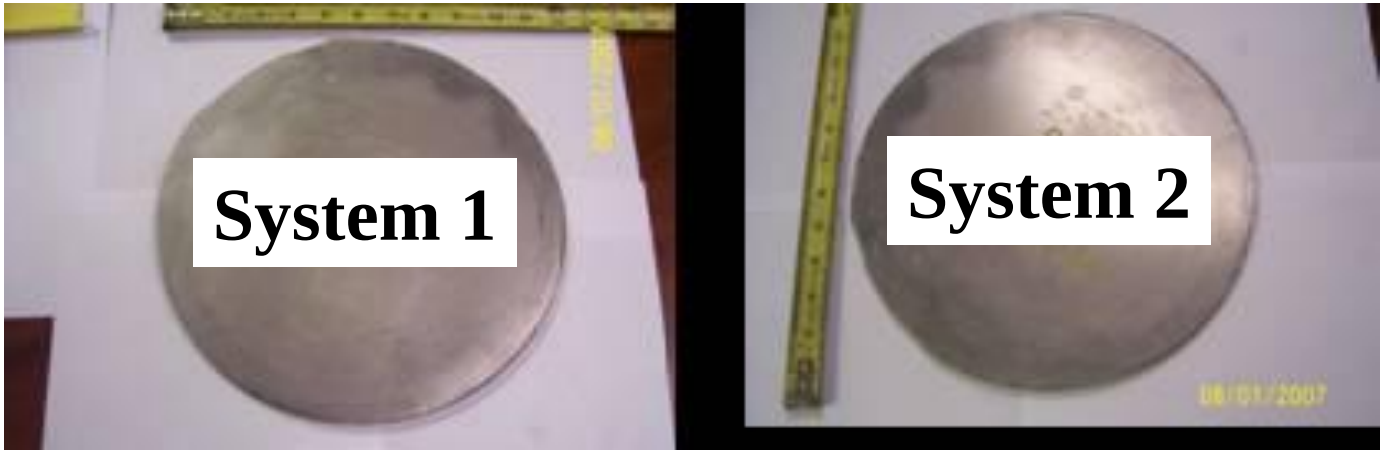
Mirror Techniques

Replicate

Other Techniques
CVD
Plating/Electroless Plating

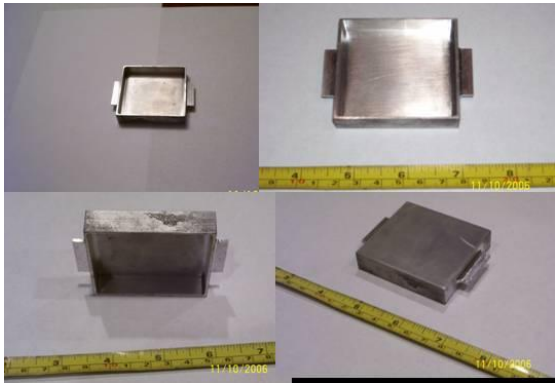
Grind
Polish
Diamond
Turning

LARGE SCALE MIRRORS



MTD
July 31,2007

Additional Parts



Summary

Variation in Properties

Property	APS Composites
Density (g/cm3)	1.0-3.0
Modulus (MSI)	12-35
.2% Yield Str (KSI)	22-90
Elongation (%)	1-8
Thermal Conductivity (W/m*k)	60-210
CTE (ppm/C)	7-17

MTD
July 31,2007

Phase I has Resulted in a Viable Material

	APS Composites
Shielding Aspects	Yes
Lightweight	1.0-3.0 gm/cm3
Manufacturing	6-10 Days
Machinability	Yes
Toxicity	No
Joining	Yes
Cost	Low-Med
Modulus	Variable
Isotropic	Yes

MTD
July 31,2007

NASA Northwestern University Team

Prof. Mel Ulmer: Has lead programs in X-ray optics replication, design, testing, multilayer application and characterization. Branched out into: light weight UV/Vis IR (Illinois large aperture telescope consortium) and deployable optics for Earth observing (with Ball Aerospace).

Research Prof. Mike Graham: Expertise in materials, coatings, ion etching, sputtering, plasma spraying (initial APS connection), surface characterization.

Research Prof. Semyon Vaynman: Expertise in electroforming, electro-chemistry, materials, material analysis, and adhesion chemistry.

Future Work Phase II

More Mirror Specific Testing/ Larger Scale

Mirror Test/Coatings for specific requirements
Vibration
Thermal Distortion
Machining Characteristics
Hermetic Sealing and others

Larger Scale

1) **36” inch diameter mirror for Ground Based Astronomy**
2) **Specific Proprietary Parts with Primes**