PennState
Applied Research Laboratory

ARL Penn State Capabilities in Surface Engineering

a presentation for the

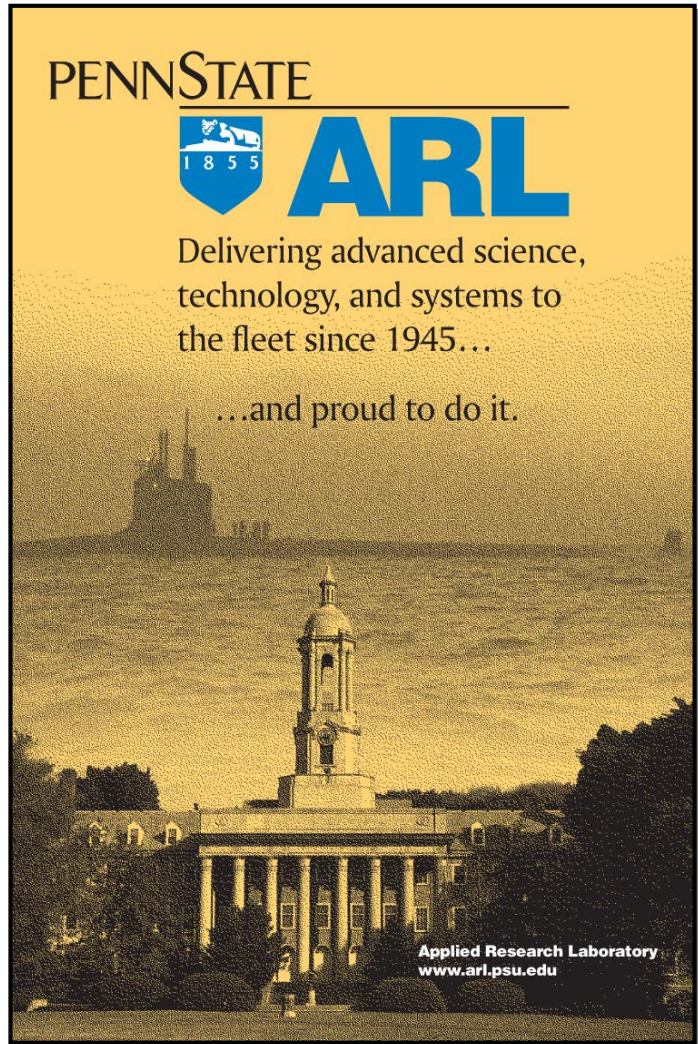## NCMS–Boeing Next Generation Surface Engineering Technology Workshop

Saint Louis, Missouri

10 October 2017
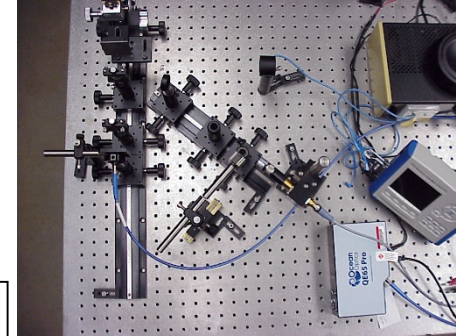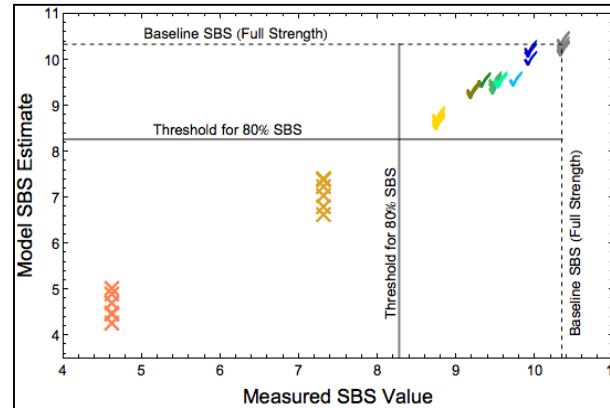
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ARL
Delivering advanced science, technology, and systems to the fleet since 1945…

…and proud to do it.

Applied Research Laboratory
www.arl.psu.edu

- **Established in 1945 by the Navy post WW II**
- **Technology Areas**
  - **Undersea Weapons**
  - **Undersea Vehicles/UUV's**
  - **Hydrodynamics and Structures**
  - **Acoustics & Quieting**
  - **Comms and Information**
  - **Power and Energy**
  - **Navigation**
  - **Materials & Manufacturing**

- **Largest Interdisciplinary Research Unit at Penn State – 1140 faculty/engineers, staff, students**
- **FY 17 Funding Expenditures - $ 200+M**
- **Designated an University Affiliated Research Center in 1996**

"…maintains a special long-term strategic relationship with DoD for technology development and engineering applications."

- Polymer Matrix Composites (PMCs) can suffer strength loss exceeding 60% from exposures to high heat fluxes.

- Feasibility demonstrated to assess incipient heat damage based on changes in fluorescence spectrum.
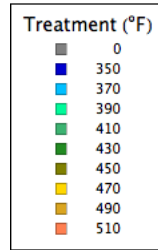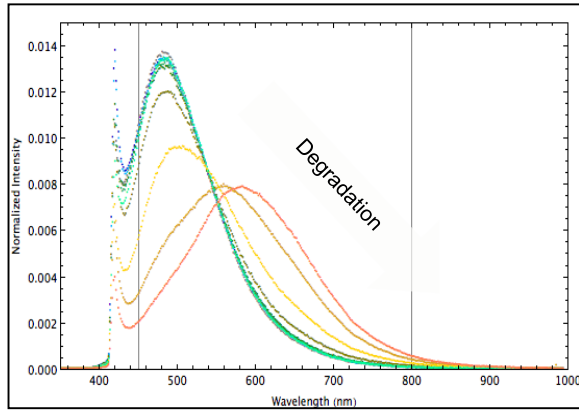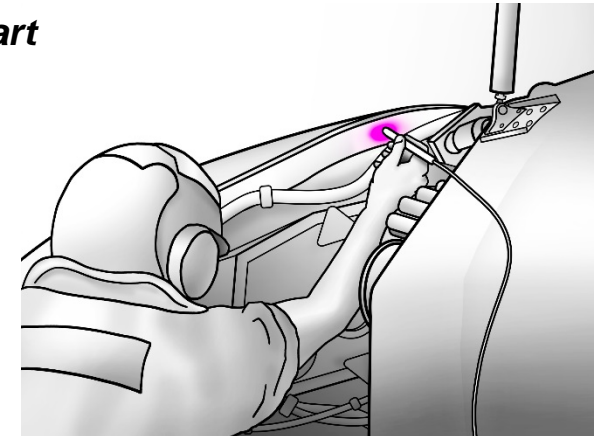

Apparatus Developed
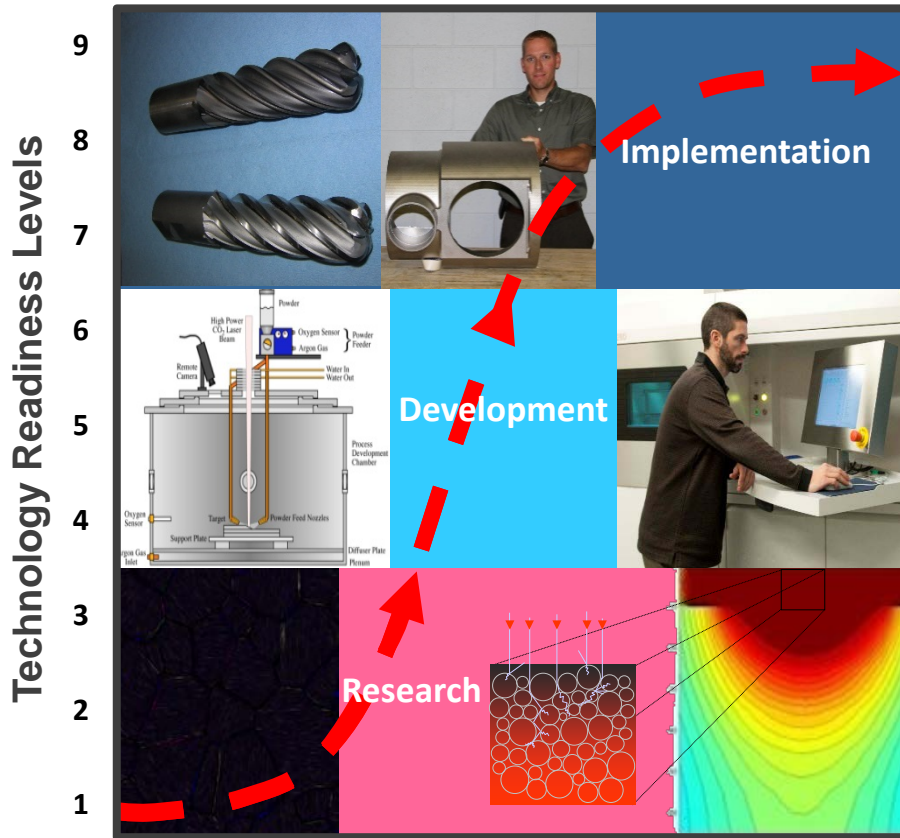

Spectral Features Change due to Heat Damage
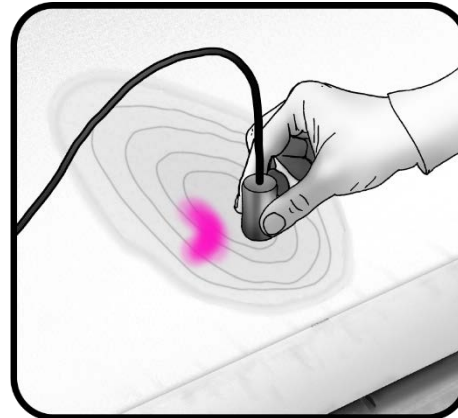

Validation Chart

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## Center for Innovative Materials Processing through Direct Digital Deposition

Various Enabling Technologies

(Vertical axis: Technology Readiness Levels, 1–9; regions labeled Research, Development, Implementation)

- ■ A national resource for additive manufacturing technologies:
  - – university-wide initiative
  - – operated by Penn State's Applied Research Laboratory, a DoD University Affiliated Research Center (UARC)

- ■ An Additive Manufacturing Demonstration Center (AMDF) under the DARPA Open Manufacturing Program

- ■ With a mission to:
  - – advanced additive manufacturing technologies,
  - – promote adoption through process and product demonstrations, and
 - – promote and sustain additive manufacturing.

PDF
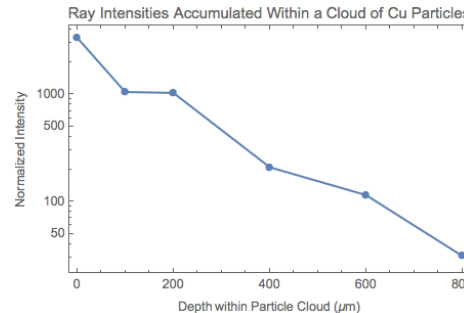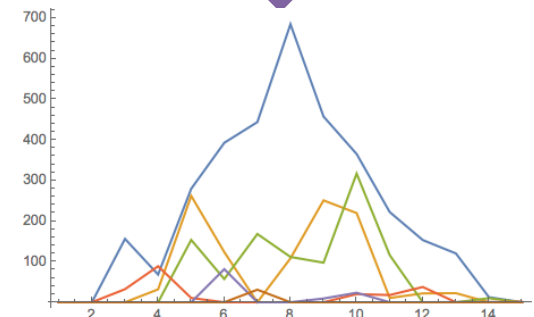

CDF
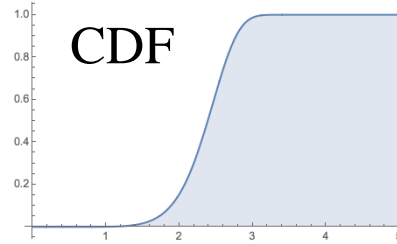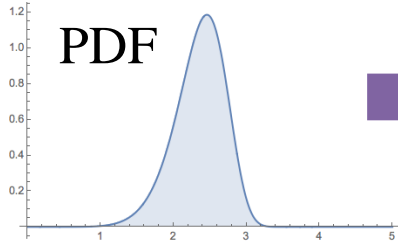
Generated Powder Bed
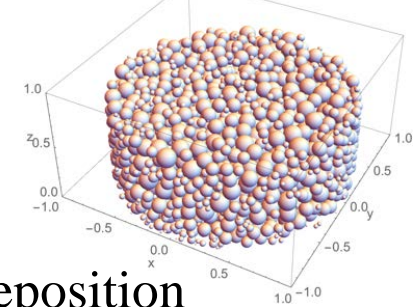
Powder Bed Generator

– Installed on same computer running the energy deposition model

– Configured to base generated powder bed on arbitrary cumulative distribution function (CDF)

– Used to generate powder beds based on two different distributions
  – Weibull
  – An experimentally measured distribution (selected arbitrarily)
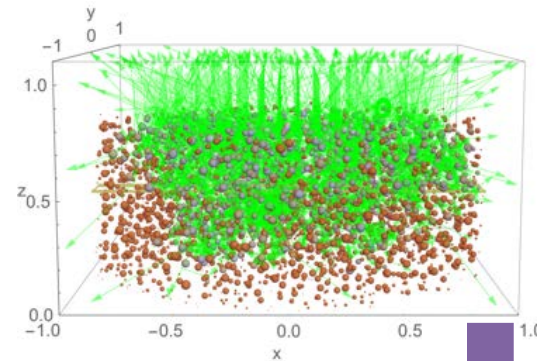
Powder Deposition Model successfully exercised against generated powder beds

Energy Deposition

Energy Deposition Profile

Ray Intensities Accumulated Within a Cloud of Cu Particles

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- Coating Technologies
  - Various techniques
    - Cold Spray
    - Evaporation
    - Sputtering
    - Cathodic Arc
  - Erosion Resistance
  - Ice Adhesion & De-Icing
  - Smart Coatings
  - Corrosion resistant coatings
- Fiber-Optic Surface Interrogation using Shear Horizontal Waves
- Drive Train Technologies
- Additive Manufacturing Technologies