

# Navy-Industry Partnership Conference

## *Sea Basing Panel*

03 August 2004

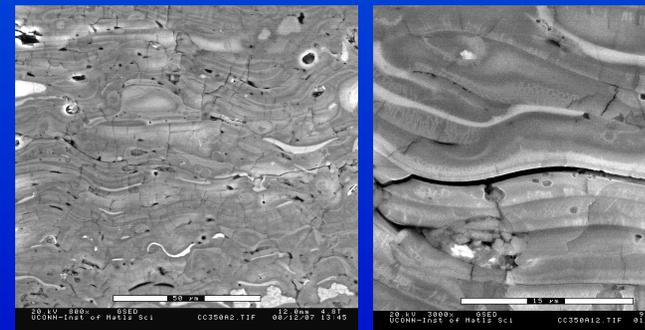
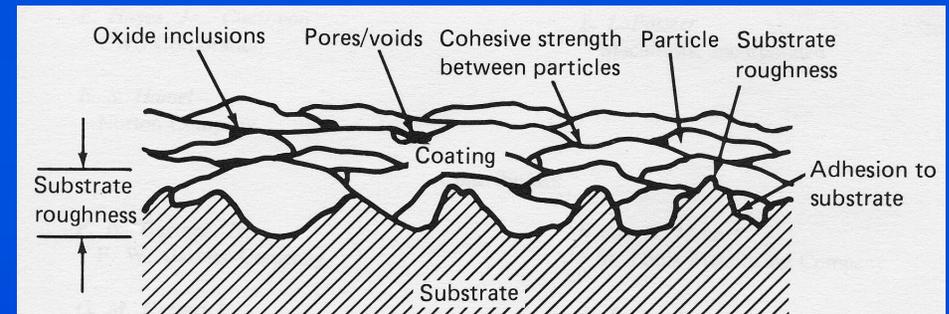
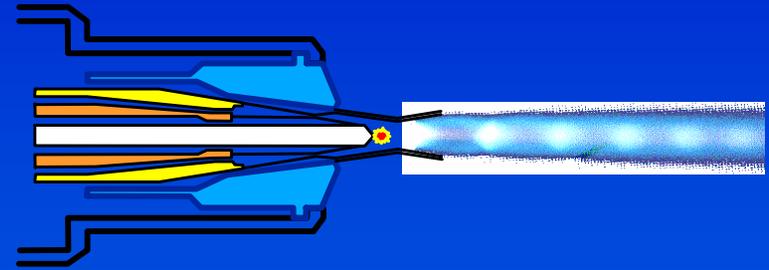


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# Traditional Thermal Spray Processing

- General Definition: Solid material is heated and accelerated toward a substrate in the form of small droplets or particles.
  - Variety of sources of heating
    - Plasma
    - Combustion of fuel
    - Electrical arc between two wires of coating material
    - High velocity “warm” gas
  - Variety of Feed Stock
    - Powder
    - Wire
- Each method has its own characteristics of velocity, temperature, and resulting microstructure.

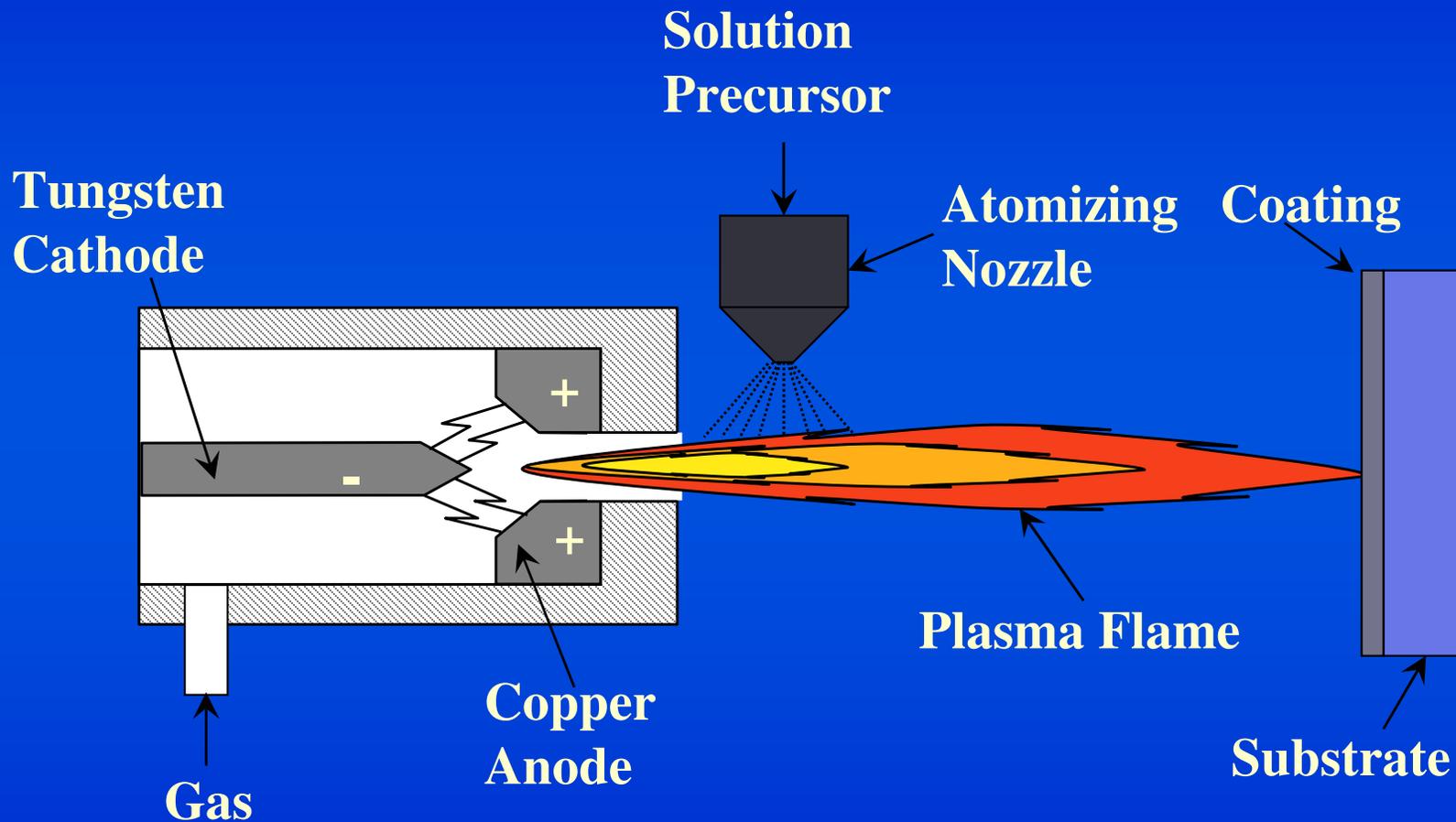








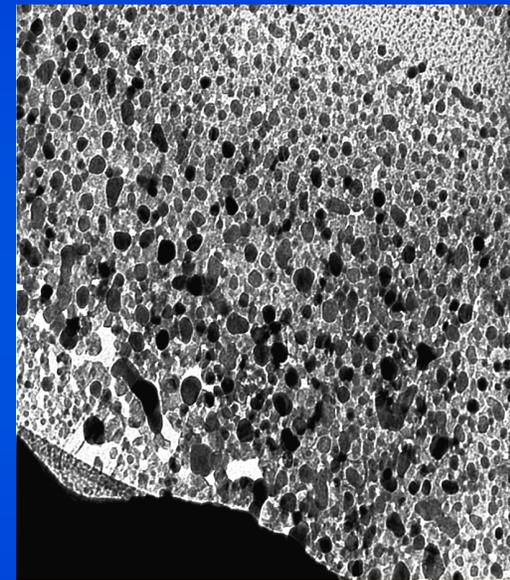
# Unconventional Thermal Spray--SPPS



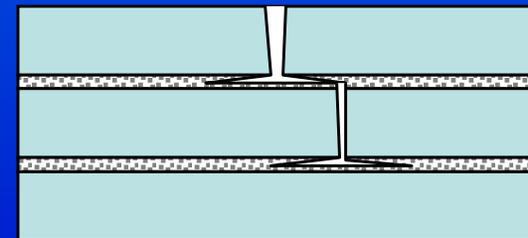
## Solution Precursor Plasma Spray

# Advantages of SPPS

- Elimination of conventional splat boundaries (nano-splats)
- Excellent composition and porosity control over small thicknesses
  - Compositional and microstructural grading
  - Integrated manufacturing
- Highly non-equilibrium compositions
- Unlimited thickness



$Y_2O_3-ZrO_2$   
(SPPS)  
Padture,

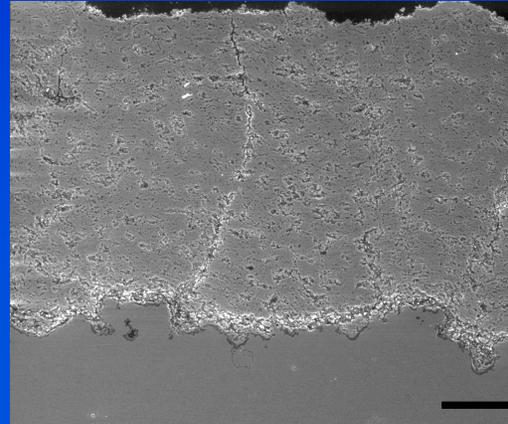
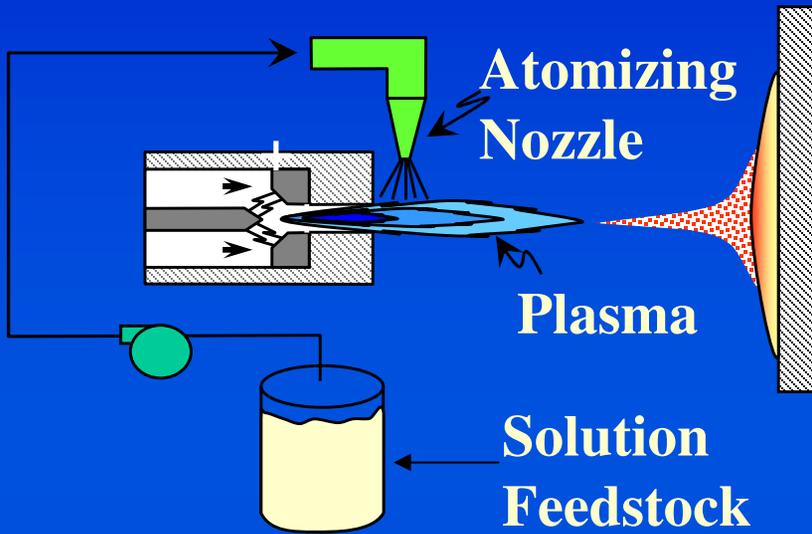


Porous or  
Weak  
Layer

**Crack Deflection/Bridging**

*Clegg et al.*

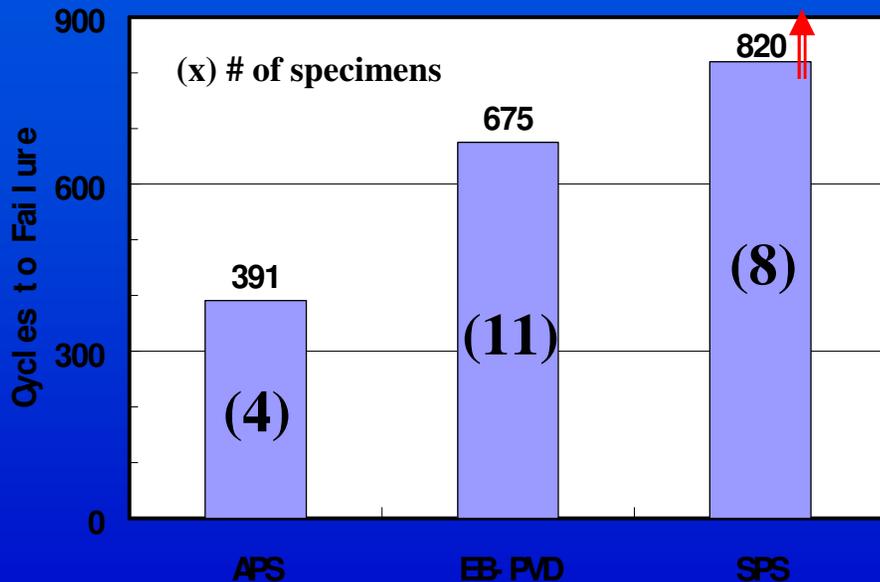
# Thermal Barrier Coatings (7YSZ)



50  $\mu\text{m}$

## Unique Microstructural Characteristics

- Uniform Porosity
- Through-Coating-Thickness Micro Cracks
- Absence of “Splat” Boundaries



## Summary of Properties

- Superior Durability To Conventional Plasma Spray & EB-PVD Coatings
- Reduced Sintering
- Ability To Make Thick Coatings
- SPS May Be Used For Wide Variety Of Coatings, Structural Preforms and Bulk Materials



# Pulsed Thermal Spray

- Miniature high rep rate rocket motor
- Powder feedstock dispersed in liquid carrier
- Whole “gun” fits into small space
  - No bottled gasses
  - No active cooling
  - No powder feeder
  - Insignificant electrical power requirement
  - *Residence time less than 1 msec*
- Direct coating of interior and shadowed surfaces
- Substrate remains relatively cool
  - Ability to coat heat sensitive materials
    - Metallic glasses
    - Nano carbides

