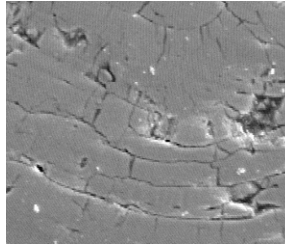


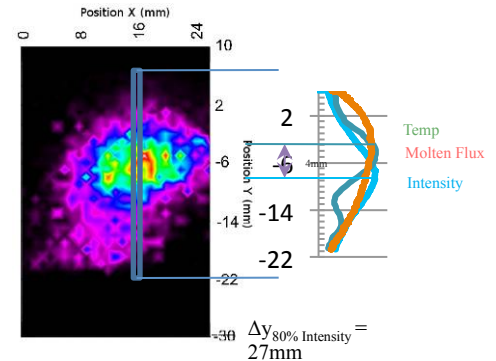
Boston University's Plasma Spray Research

Materials: Structure & Properties



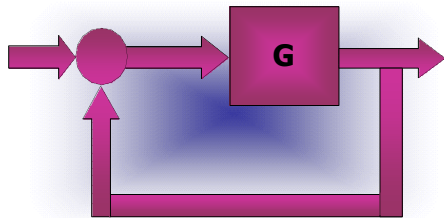
Professor Soumendra Basu

Sensor Development & Evaluation:



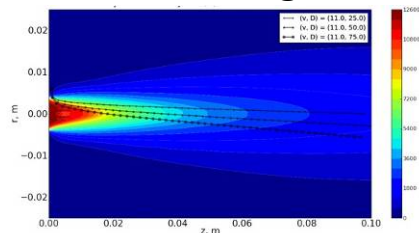
Professors Wroblewski & Gevelber,
Cyber Materials LLC

Control Design & Implementation:



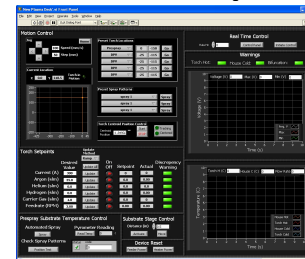
Professor Michael Gevelber

Modeling:



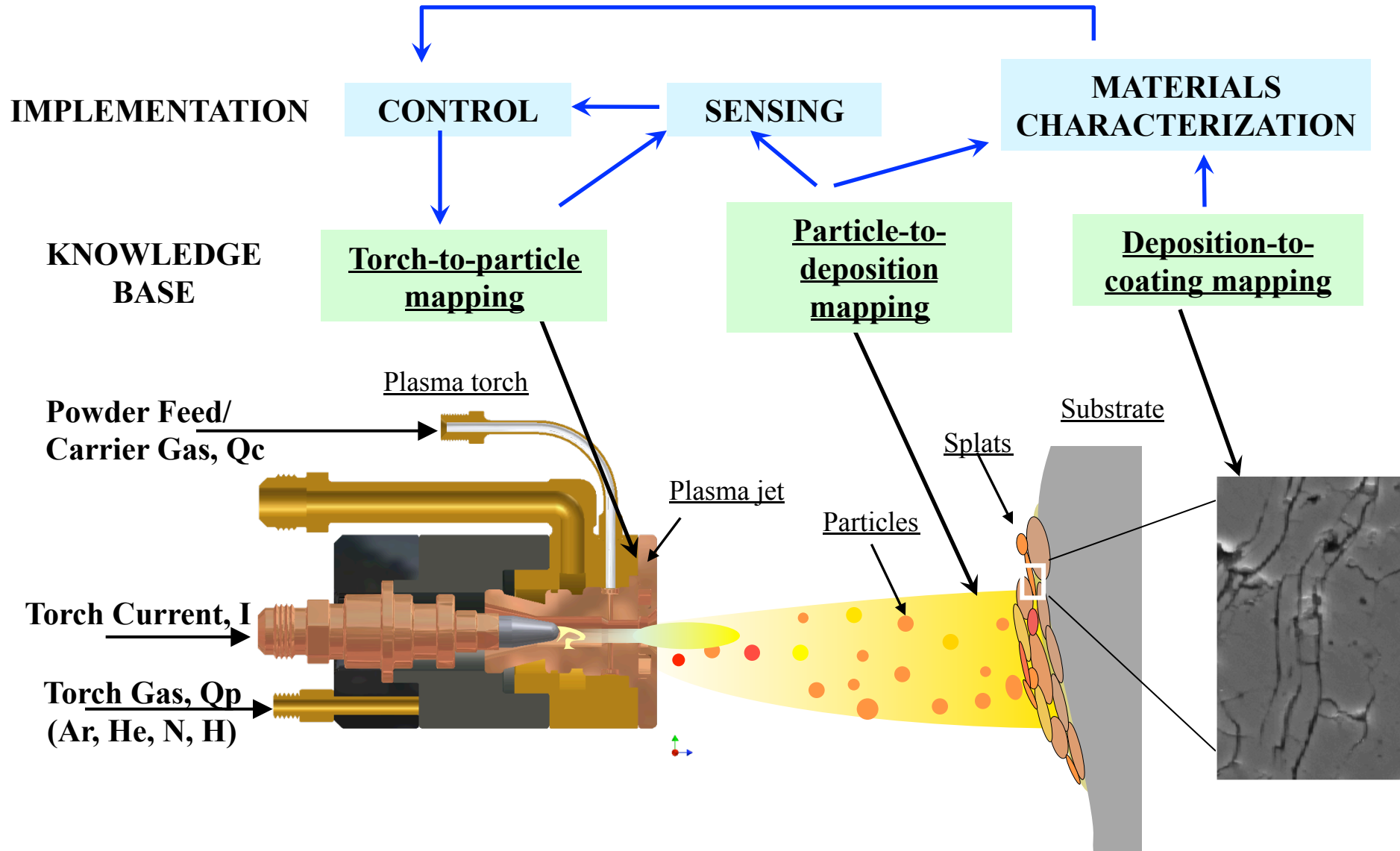
Professor Donald Wroblewski

Process Development:



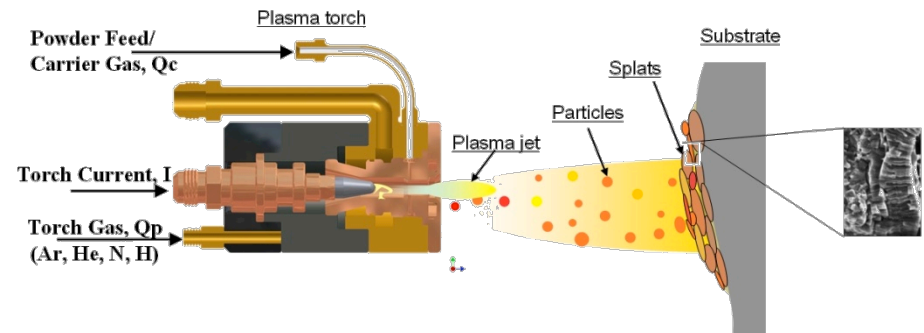
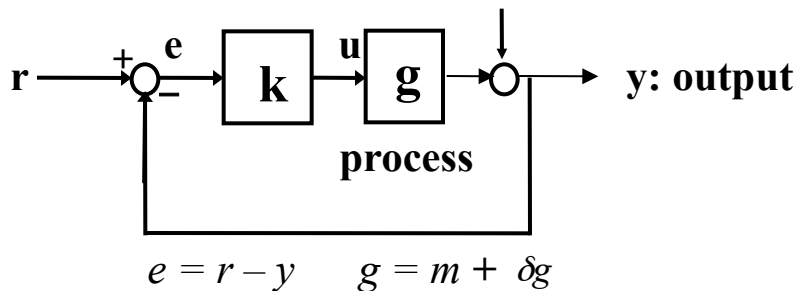
Professors Basu, Gevelber and Wroblewski

Process Overview



Market Considerations for Developing Plasma Spray Control

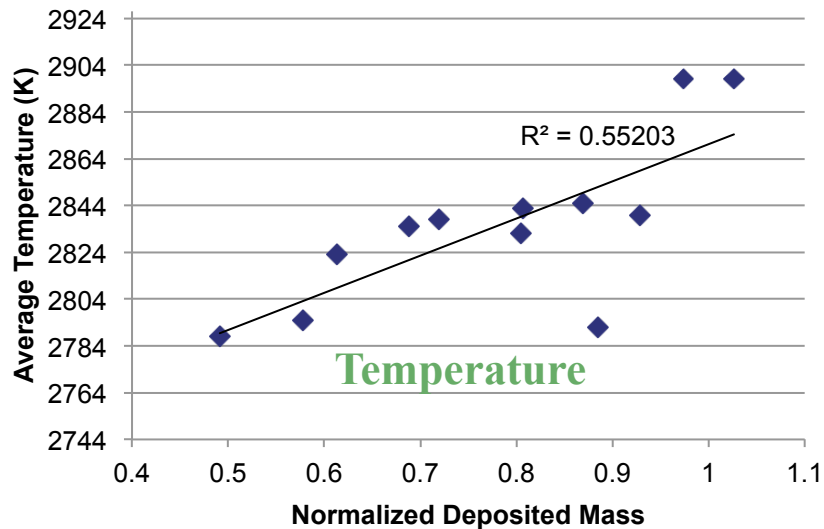
- Need to understand valve proposition to end-users
- **Tighter tolerances:**
 - thickness, material attributes (porosity, cracking)
- **Yield** → **minimize variation to reduce re-work**
- **Production/deposition rate**
- **Deposition efficiency**
- **Ability to better engineer coating structure for different applications**
- **Strategy**
 - use closed-loop control to more directly critical process states



But: what should be controlled to meet manufacturing objectives?

What Measurement Relates to Deposited Mass?

⇒ Many different sensor options, but which will provide you with a competitive advantage?

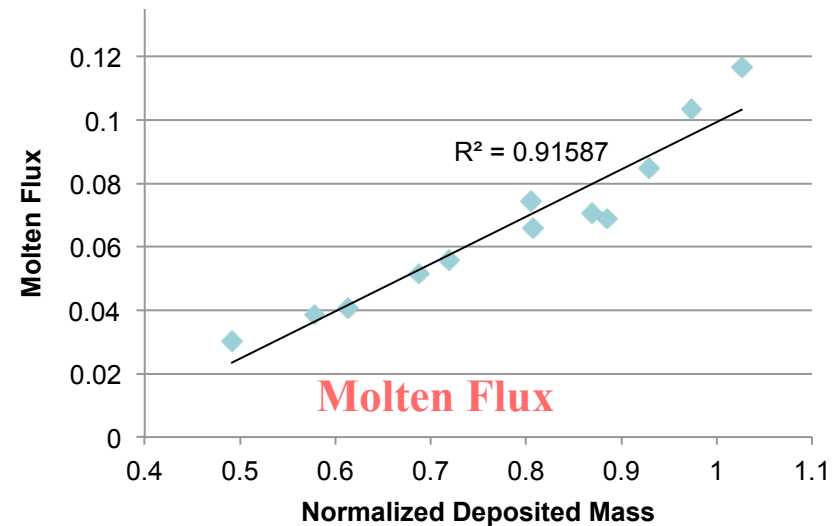


⇒ Poor sensor correlation could induce “wrong” control action

Molten Flux Correlates well

⇒ Based on **individual** particle,
but from fast whole plume scan

⇒ Developed new sensor architecture

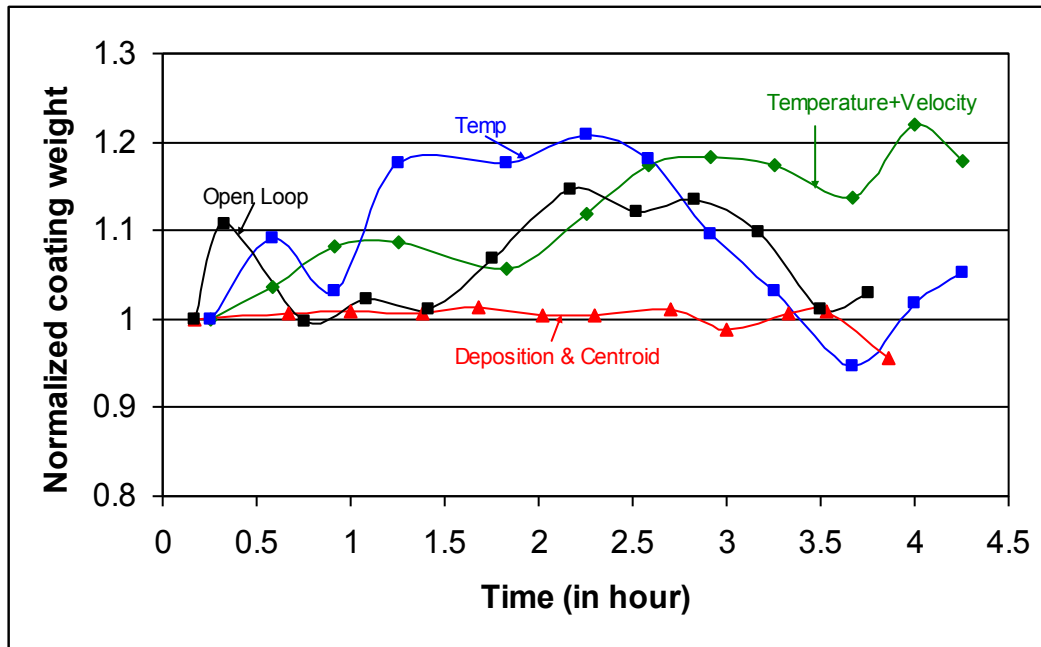


SG100 (Ar,He) YSZ (10-75)

Control Strategy Evaluation for Deposited Mass

Round-robin test: 4 hour min, power cycle every hour

Open Loop, Temperature, Temp & Velocity, Centroid & Deposition



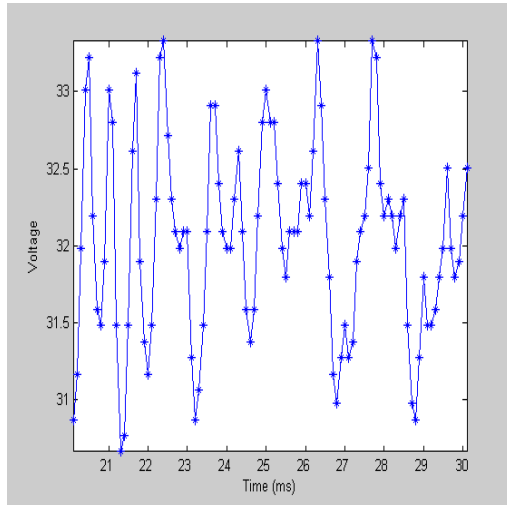
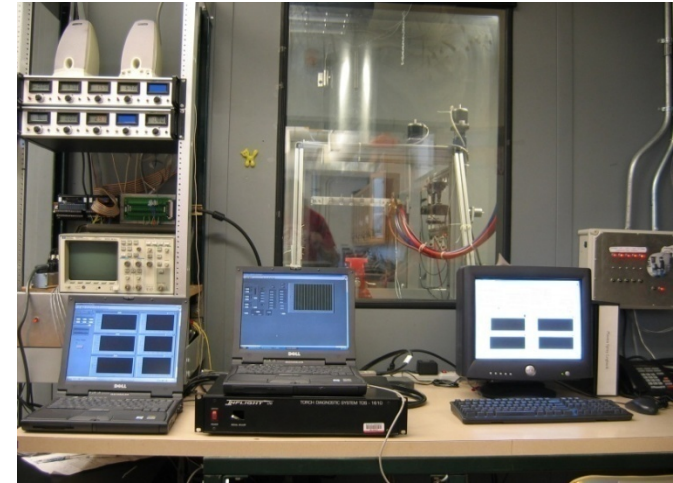
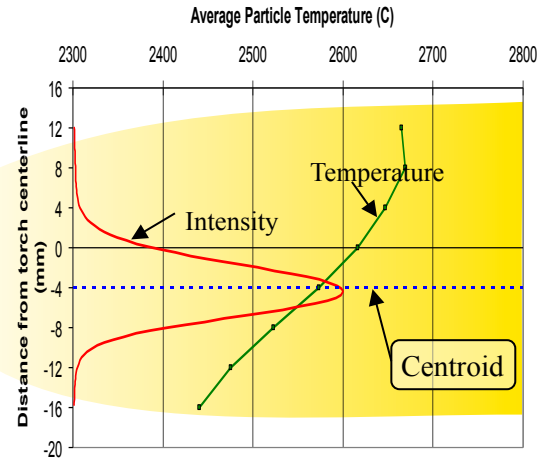
• Deposition & Y_c control is 3-10x, better than open loop

• Other control strategies make things worse

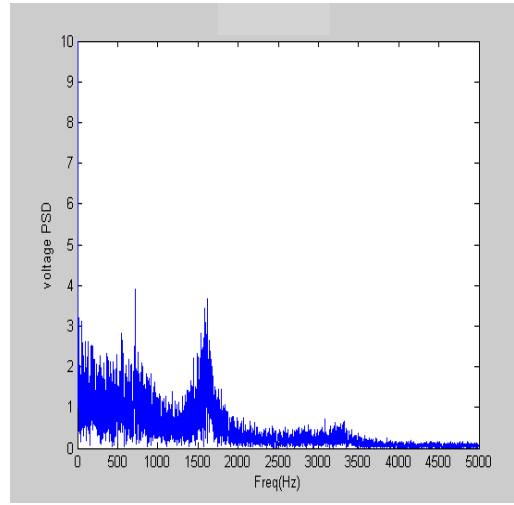
σ_N / σ_N^2	Open Loop	Tp Control	Tp&Vp Control	Dep & Y_c Control
Mass	1/1	1.47/2.17	1.15/1.32	.30/.09

BU Particle/Torch Diagnostics and Control Capabilities

- plume intensity
- individual particle: temp, velocity, & diameter
- spatial average temperature
- acoustic signature
- high frequency volt/current
- real-time control



Voltage: 0.1 ms sample



Voltage Freq. Spectrum

