Kinetic Metallization Equipment

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Kinetic Metallization is not Coldspray

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Comparison

He, 250C, Cu alloy		Kinetic Metallization 100psia	Coldspray (e.g., CGT) 300psia
Gas Consumption	SCFM	11	135
Powder Feedrate	g/m	30	34
Deposition Efficiency	%	90	90
Deposition Rate	g/m	27	30

Comparison

- Coldspray nozzle diameter is twice that of Kinetic Metallization X4
- Coldspray pressure is three times that of Kinetic Metallization X3
- Coldspray gas flow is 12 times that of Kinetic Metallization X12
- Coldspray powder loading is 1/20th that of Kinetic Metallization X0.05
- Net result is coldspray consumes TWELVE times as much gas per gram of powder deposited

Some questions to ponder

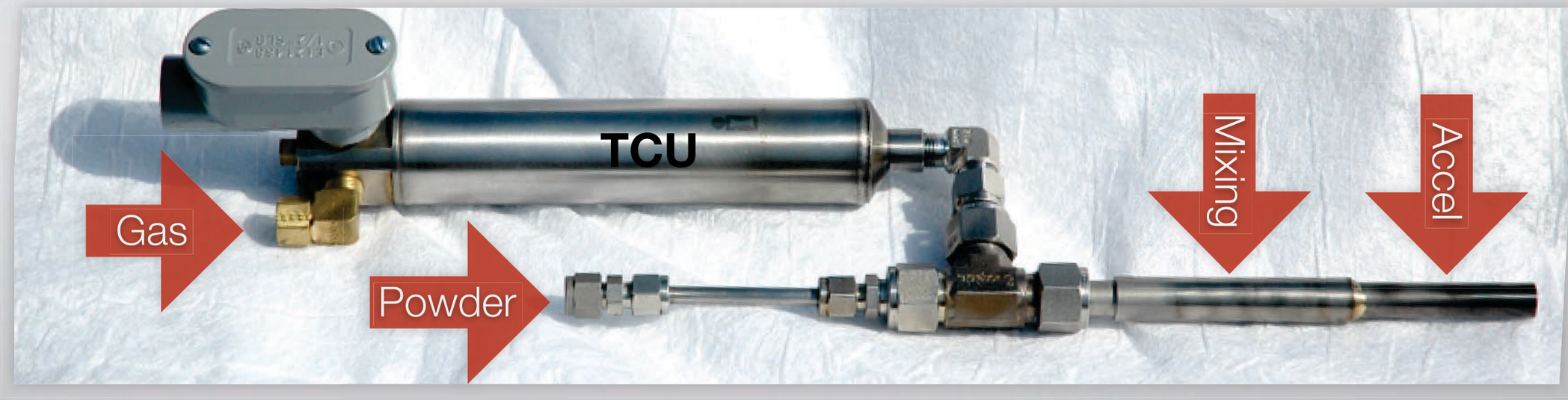
- Why are coldspray systems so big?
- Why are coldspray systems so heavy?
- Why do coldspray systems get bigger and heavier every year?
- Don’t most technologies get smaller as they are refined?

KM System Components

- Deposition Gun
- Control Cabinet
- Powder fluidizing Unit
- Manipulation equipment
- Gas Control Panel

KM Deposition Gun

- Low mass TCU
  - Quick heat-up
  - Low thermal inertia
    - Minimum temperature overshoot/undershoot
- Mixing Chamber
  - Thermal/mass equilibrium
- Friction compensated sonic nozzle



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KM Deposition Guns
Common Technology
Interchangeable Parts

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Powder Fluidizing Unit

- Large Capacity - 4 hour run time
- Patented Brush-Sieve Design
- Light-weight pressure vessel
- Feed Rate independent of gas flow rate
- Real-time feed rate adjustment
  - Gas flow independent
- Powder Size: 500nm - 50µm
- Feed Rate: 1-100g/min

Gun Automation

- 6-axis or 4-axis Robot
- Coordinated rotation axis

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Production Coating System

- Dual powder fluidizing units
  - Continuous operation
  - Dual-layer coatings
- Closed loop pressure control
- Gas mass flow metering
- Gas blending enabled
- Human machine interface
- Real-time system control

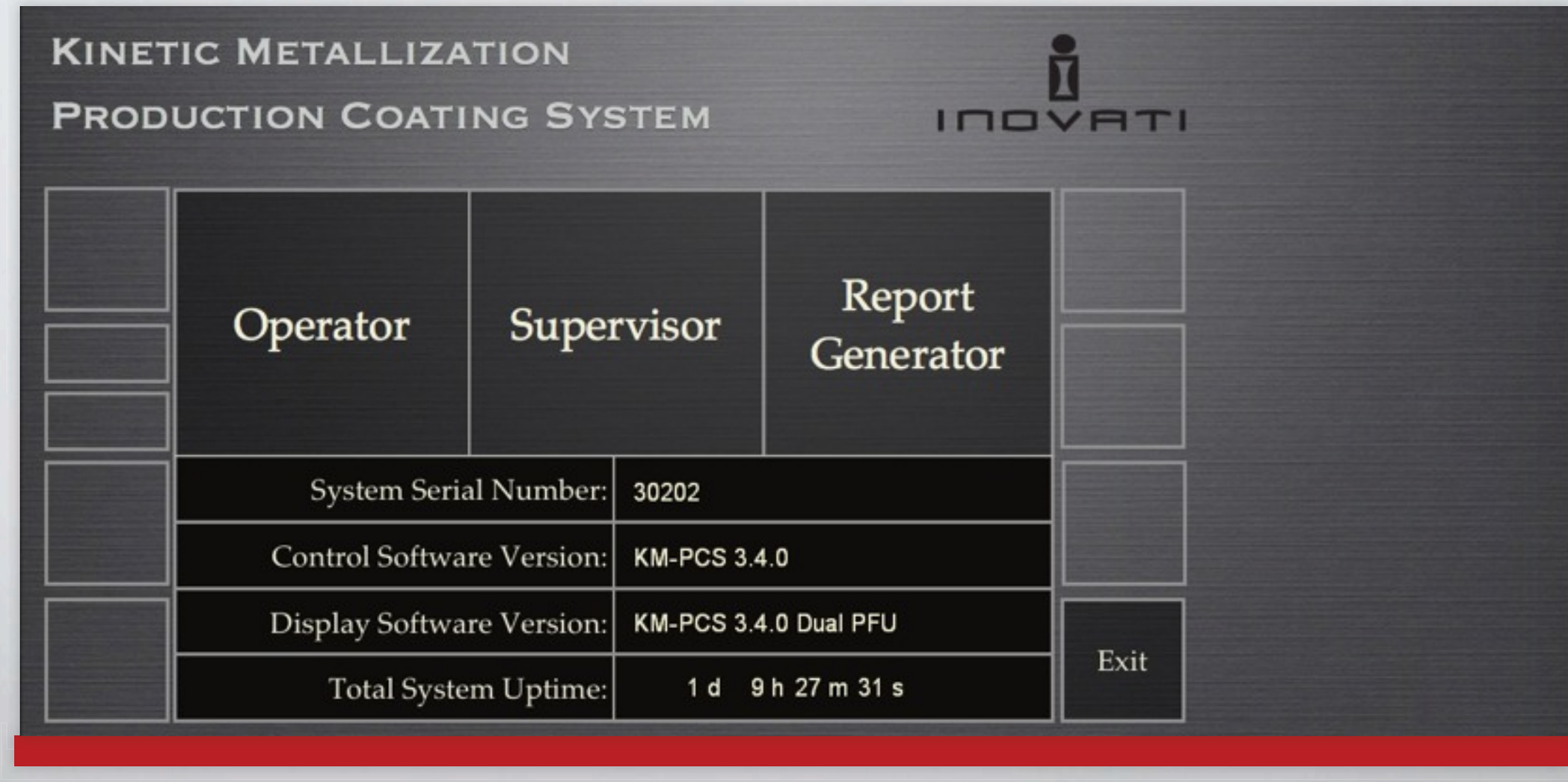
New Developments

- Onboard gas blending
- Advance HMI
  - Supervisor Mode
    - Receipt definition
  - Operator Mode
    - Receipt use
- Pre-formatted reporting
  - System identification
  - Trend plot
  - Parameter statistics

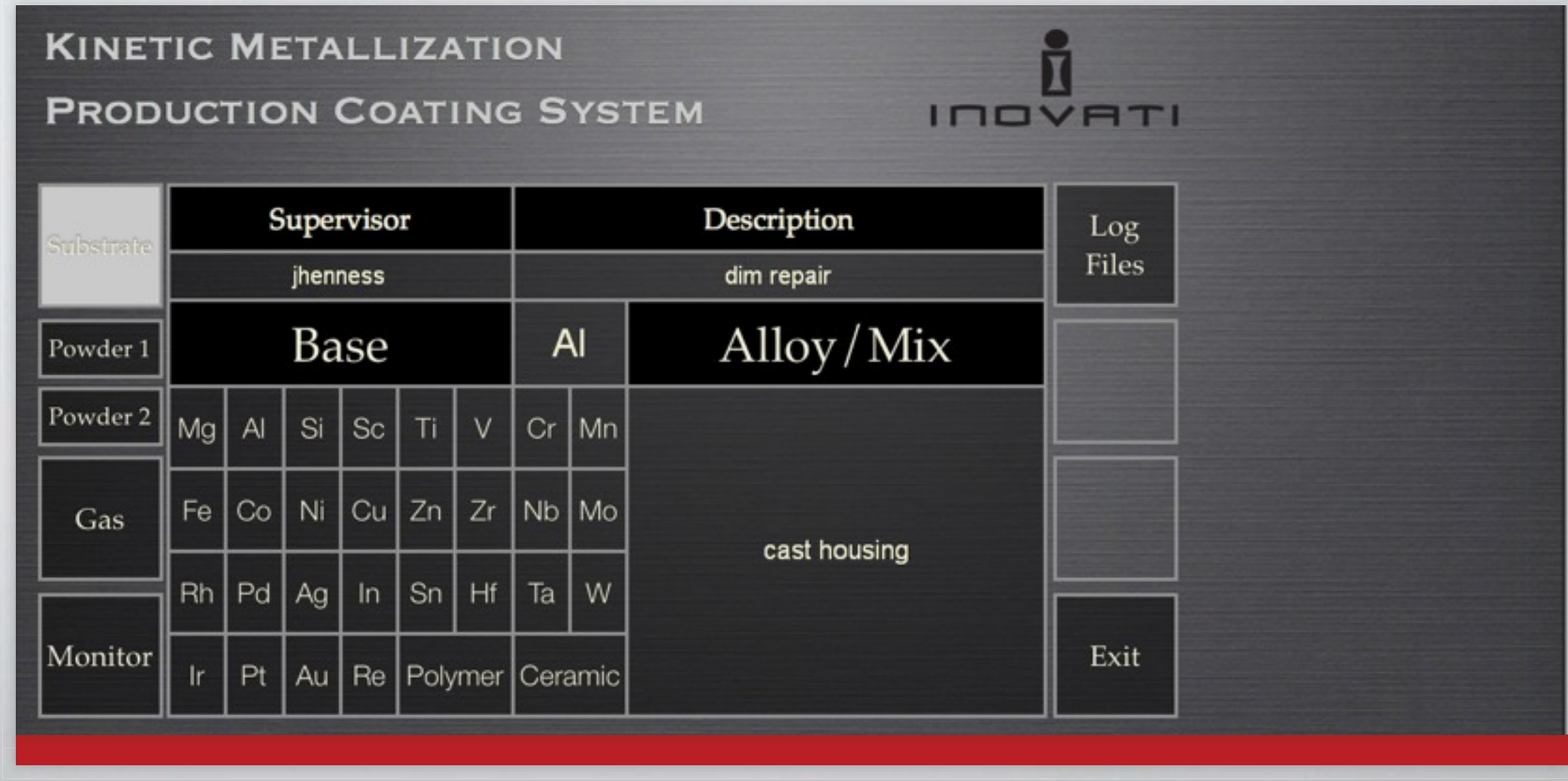
Gas Panel

- Mixed or Single gas
  - Onboard mass flow control
    - CDS and PCS
  - Minimum flow variations
  - Constant flow split
    - PFU
    - TCU

Startup Mode



Supervisor Mode



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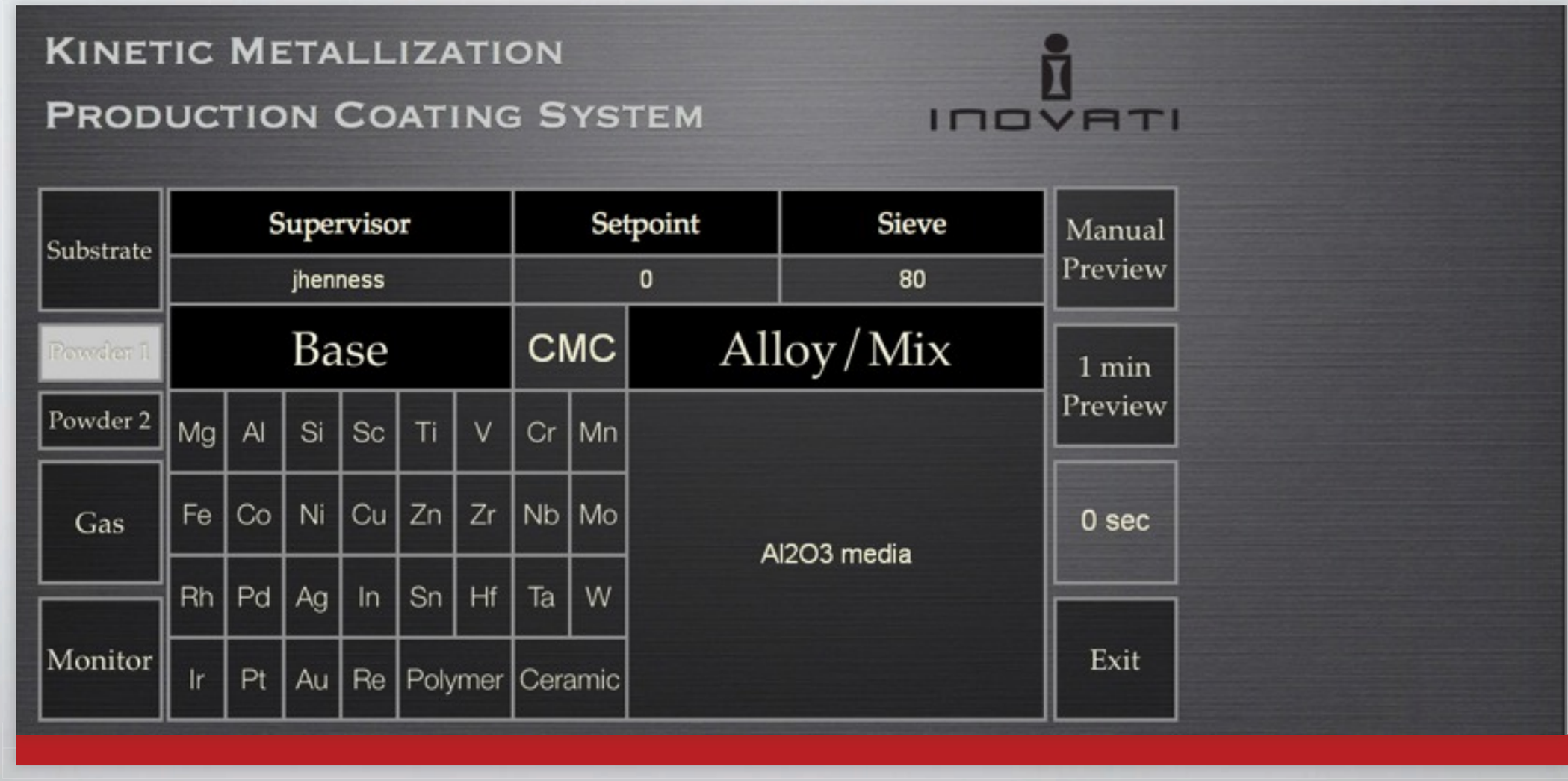
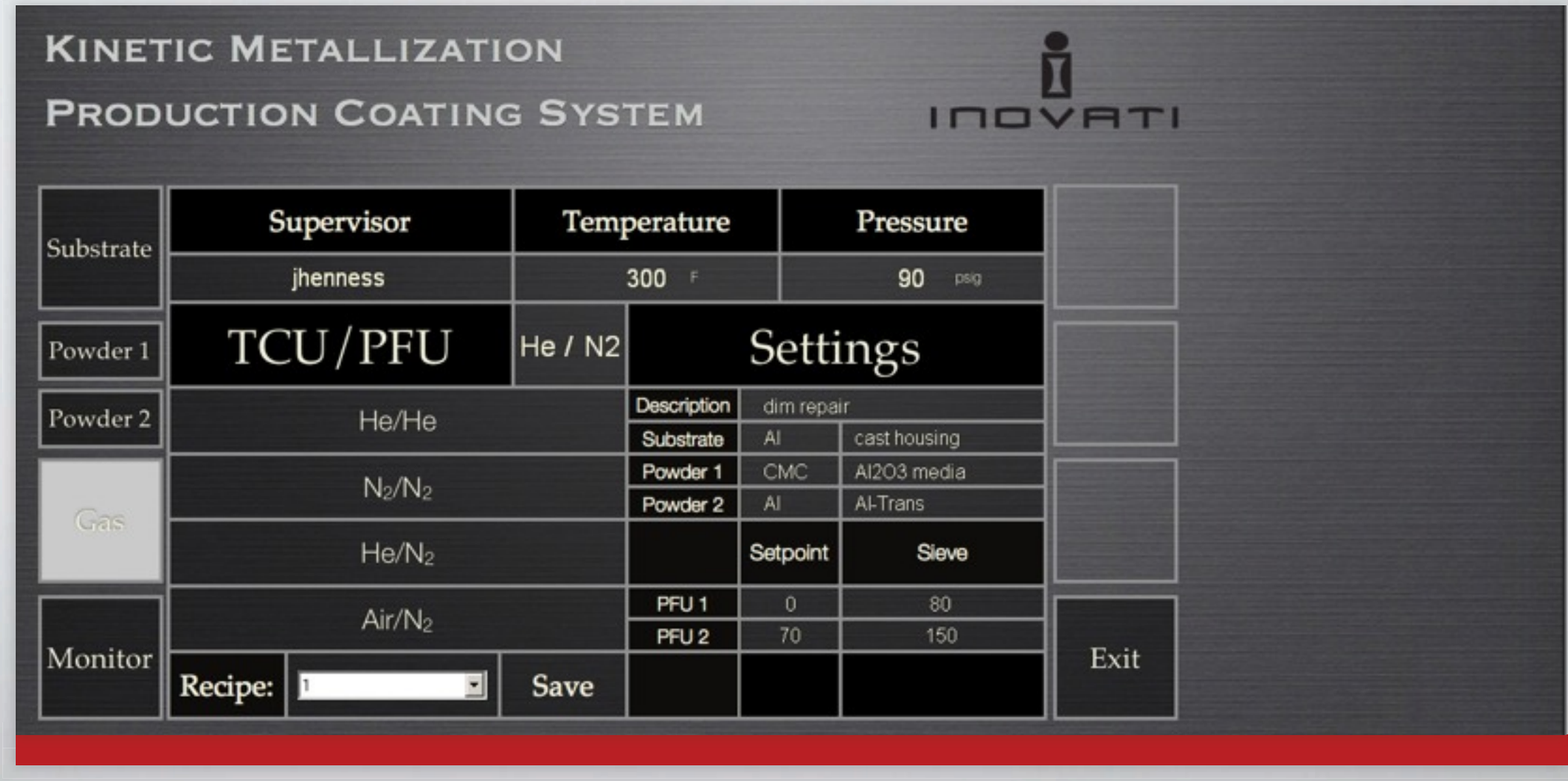
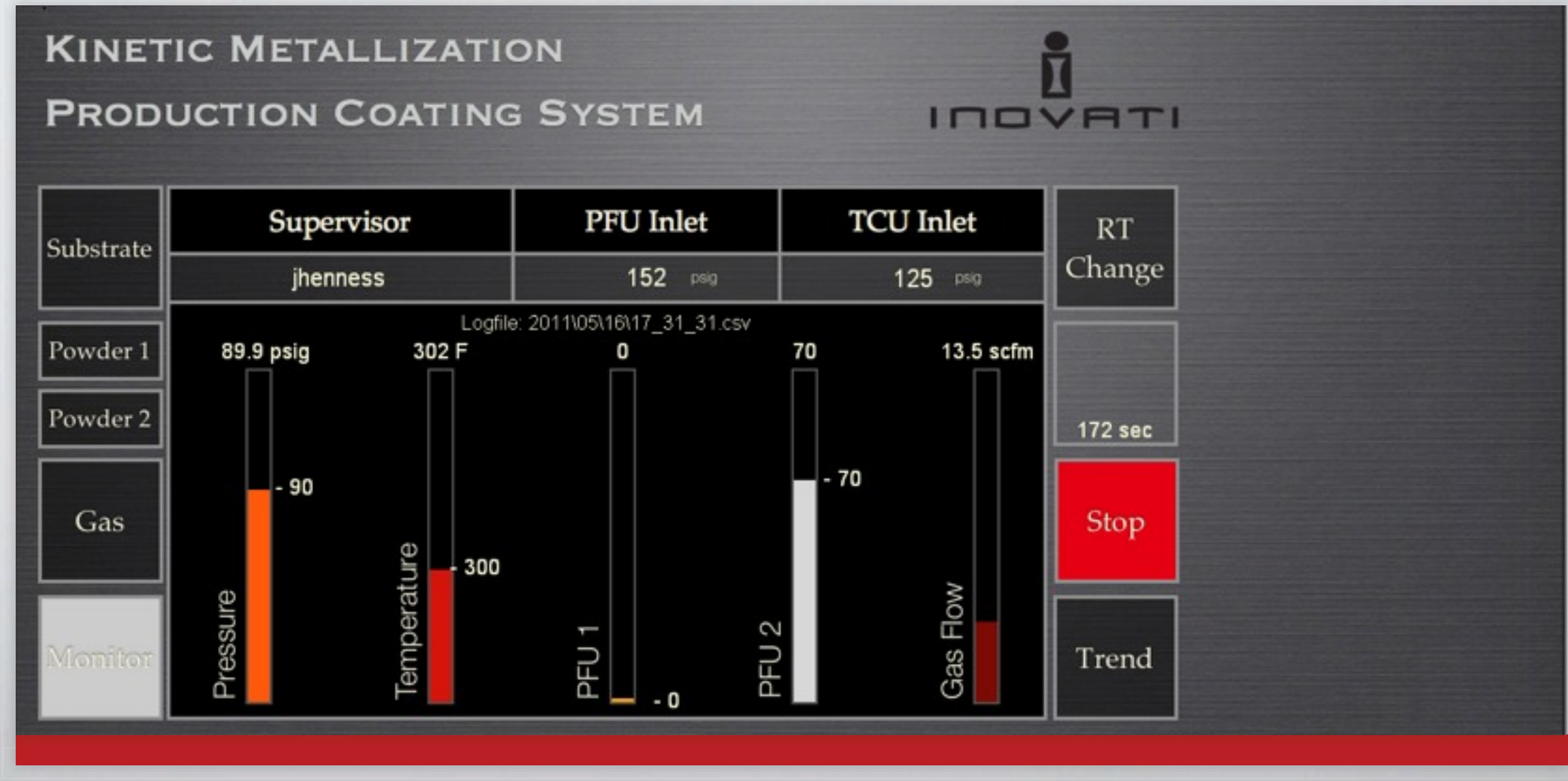
Powder Parameter



Gas Parameter / Recipe Save



Run Mode


KINETIC METALLIZATION
PRODUCTION COATING SYSTEM
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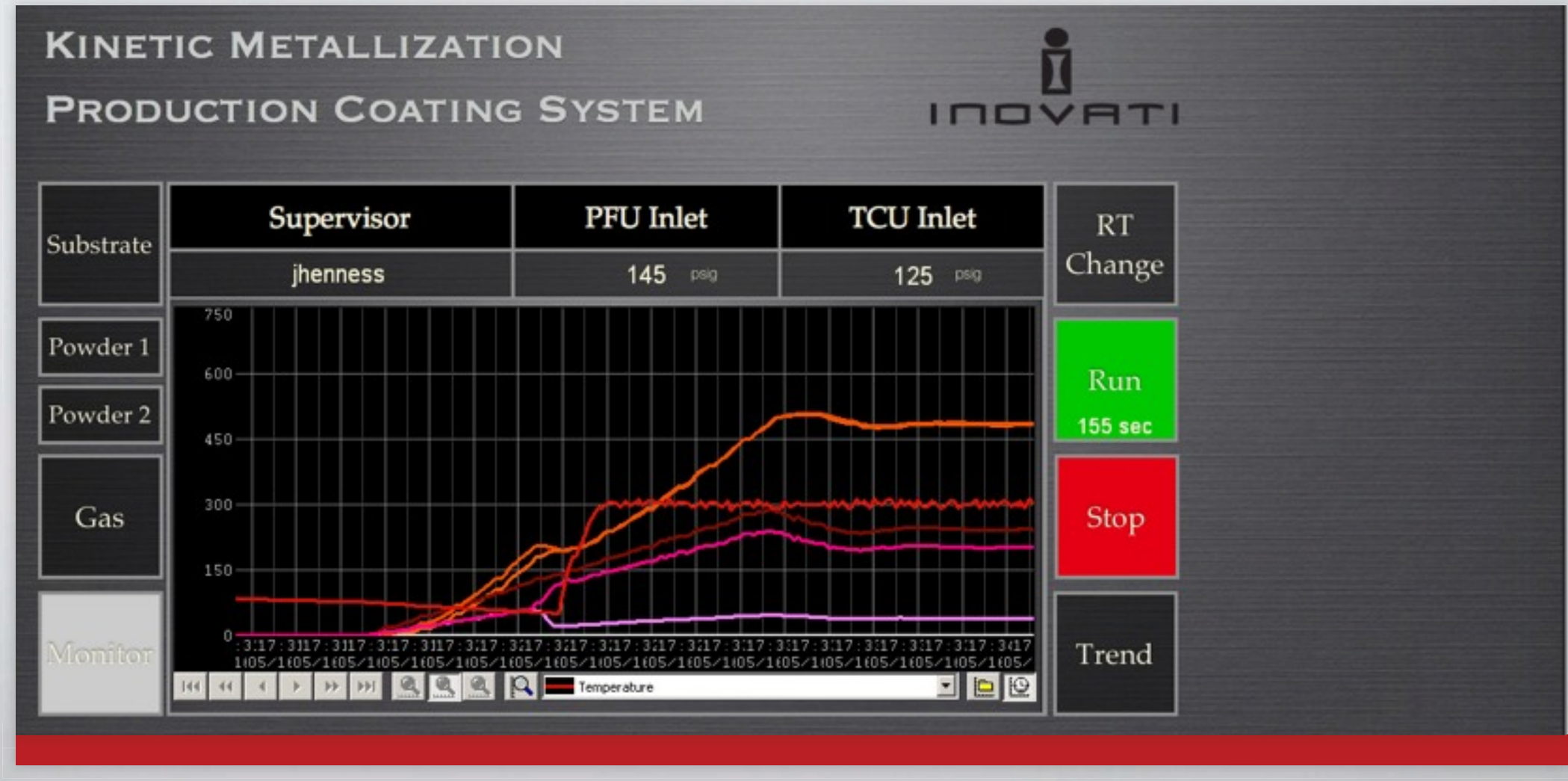
Substrate
Powder 1
Powder 2
Gas
Monitor
Supervisor
jhenness
PFU Inlet
152 psig
TCU Inlet
125 psig
Logfile: 2011\05\16\17_31_31.csv
89.9 psig
- 90
Pressure
302 F
- 300
Temperature
0
- 0
PFU 1
70
- 70
PFU 2
13.5 scfm
Gas Flow
RT Change
172 sec
Stop
Trend

Trend Plot


KINETIC METALLIZATION
PRODUCTION COATING SYSTEM
INOVATI
Substrate
Powder 1
Powder 2
Gas
Monitor
Supervisor
jhenness
PFU Inlet
145 psig
TCU Inlet
125 psig
750
600
450
300
150
0
Temperature
RT Change
Run
155 sec
Stop
Trend

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Mobile Coating System

- Integrated cabinet on portable cart
  - Brush-sieve PFU for ultra-fine powder feeding
  - Temperature range to 350C
  - Pressure range 50-130 psig
  - Gas Blending He, GN2, Air
  - Dual PFU
    - Powder blending or grit blasting
  - Quiet 75 dBa

KM-MCS

- Handheld KM Gun
  - Round or oval WC sonic nozzles (noise < 75 dba)
  - Standard light-weight KM TCU & Gun (< 5 lbs)
  - Powder injection at converging inlet
  - Powder preheating with nozzle mixing chamber

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KM Coatings

- Ag
- Al/Zn
- Al-4047 -Al/Si
- Al-6061
- Al-CP
- Al-Trans -Al2O3
- Al-Trans- Co
- Al-Trans- Cr
- Al-Trans-Mo
- Al-Trans-Ni
- Al-Trans-SiC
- Al-Trans-SS
- Al-Trans-Ti
- Al-Trans-TiC
- Al-Trans-V
- Amorphous
- Al
- Fe
- Ni
- Au braze alloy
- C103
- Co
- CoCr
- CoNiCrAlY
- CoNiCrAlY/CBN

KM Coatings

- Cr
- CrC/NiCr
- Cu
- Cu/SiC
- CuAlFe
- CuCr
- CuCrAl
- In
- In718
- Mo
- Nb
- Ni
- Ni/CBN
- Ni-braze
- NiCrAlY
- Nitinol
- Re
- Reactive Intermetallic Compounds

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KM Coatings

- Sn
- SnAg
- SnAgSb
- SS
- Ti/HA
- Ti/TiC
- Ti/TiN
- Ti6-4
- Ti-CP
- WC-Co
- Teflon, PTFE
- Ultem, PEI
- PEEK
- Nylon polyamides
- Polymer+
  - Al2O3
  - BaTiO3
  - Fused Silica
  - Quartz