

Atmospheric Processing Platform

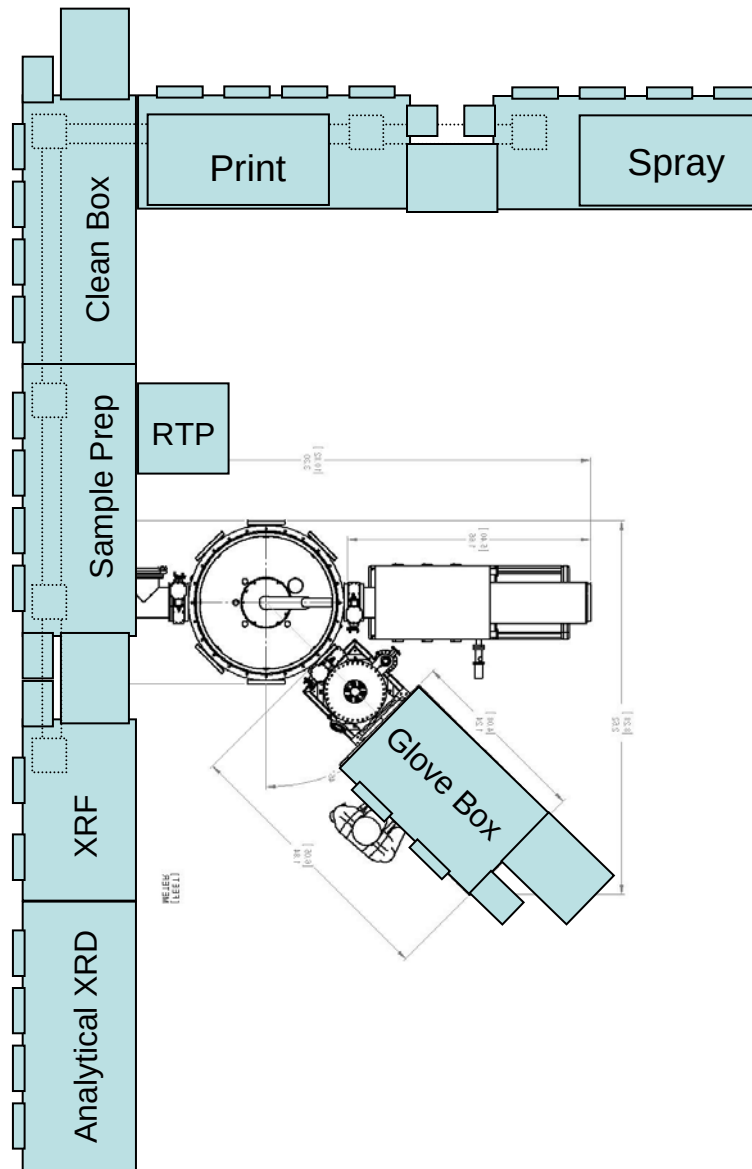


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Atmospheric Processing Platform



6"x6" substrates

Inkjet deposition

Spray deposition

Sputter deposition

Evaporation

Rapid thermal processing

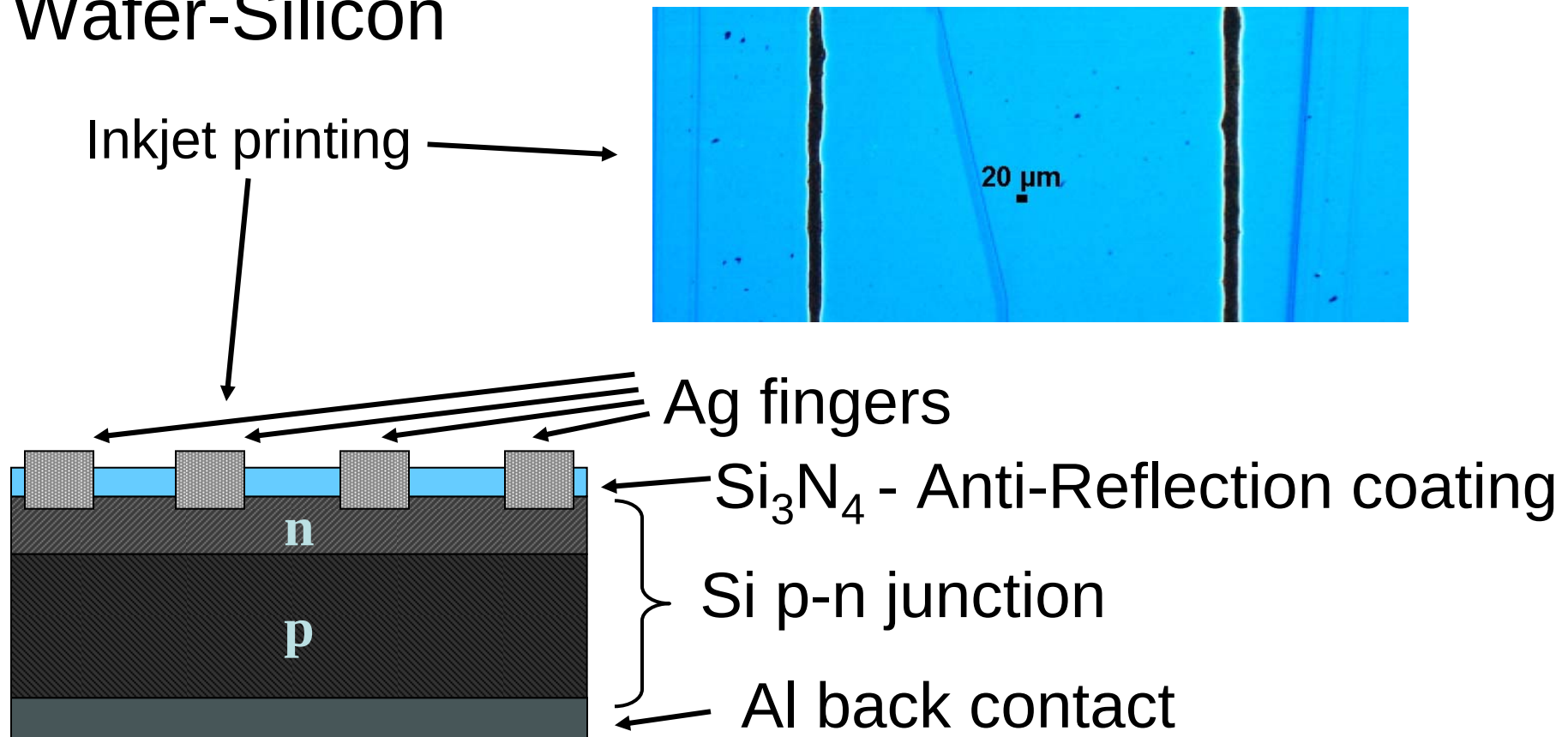
XRD analysis

XRF analysis

Atmospheric Processing in PV



Wafer-Silicon



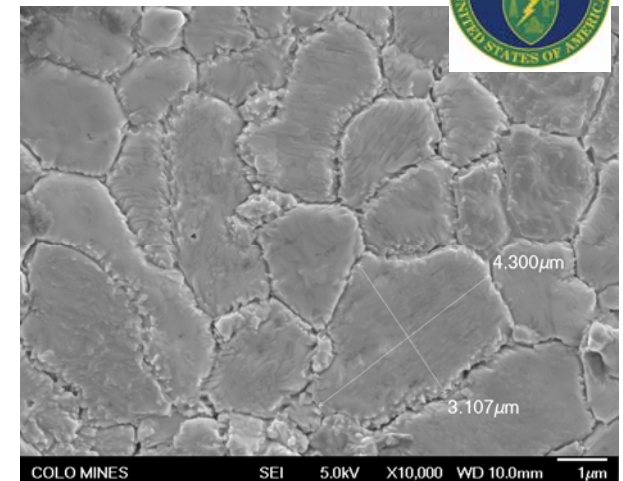
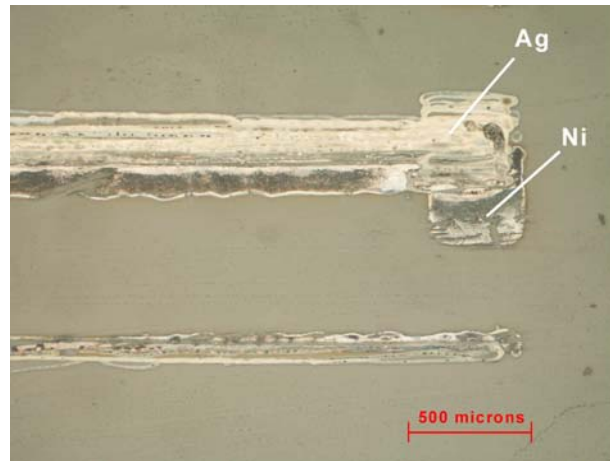
Also: Printing of dopants to form junction

Atmospheric Processing in PV



CIGS

Inkjet printing



Ni/Ag contact grid

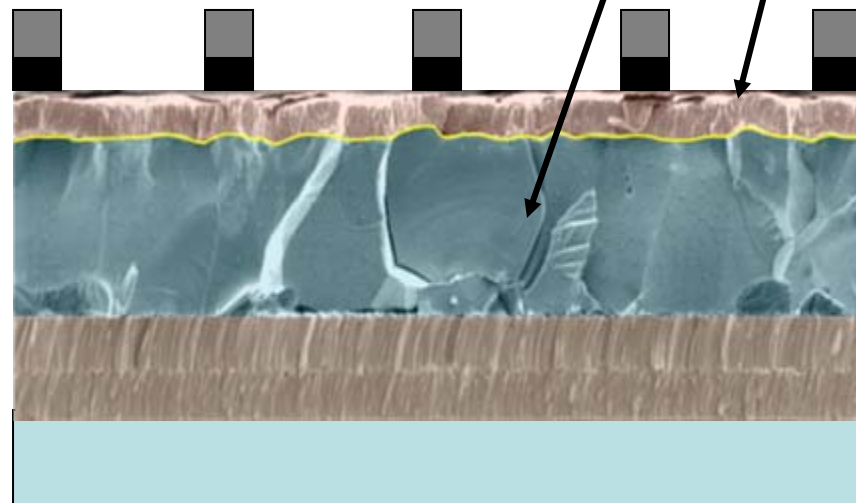
ZnO (TCO) / CdS

CIGS absorber layer

Mo back contact

Glass substrate

Inkjet printing or Spray Deposition



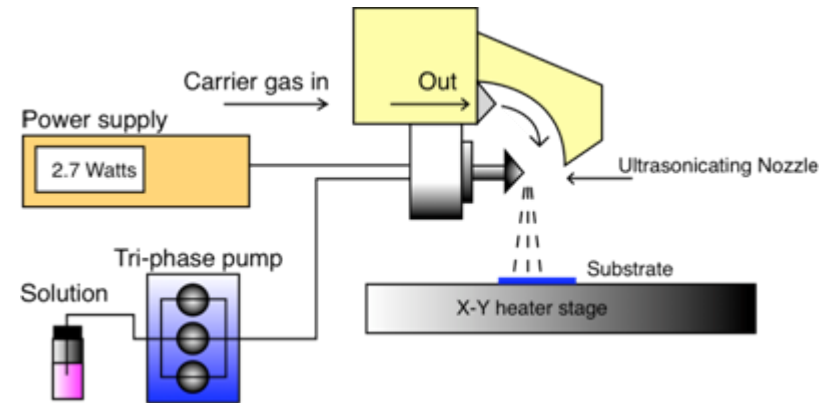
CBD

Atmospheric Processing in PV

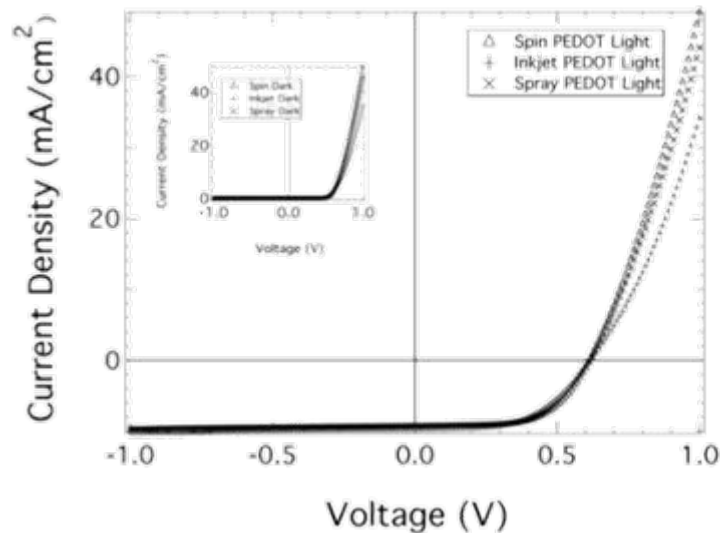


OPV

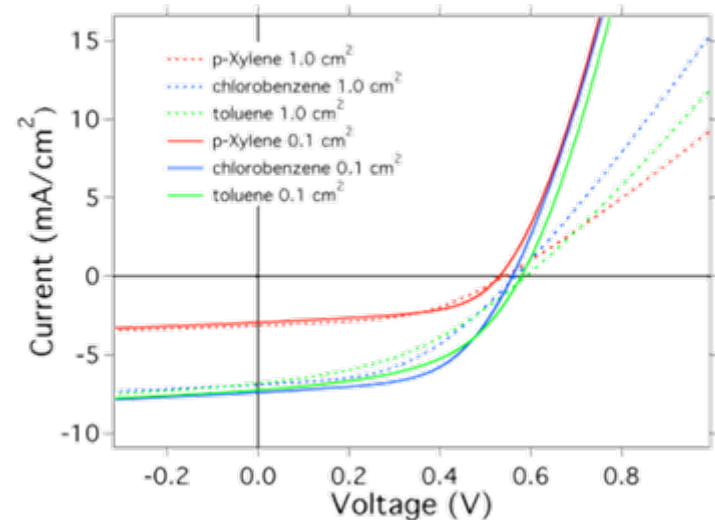
- Inkjet and ultrasonic spray produce devices comparable to spin coated for both the HIL and the absorber.
- Devices scale up in air to 1 cm² with efficiency greater than >2%
 - Setting up deposition system in glove box for increased device performance



PEDOT:PSS Deposition



Active Layer Deposition



Also....

- More OPV

Sprayed or printed:

- hole blocking layer
- absorber

Printed contacts

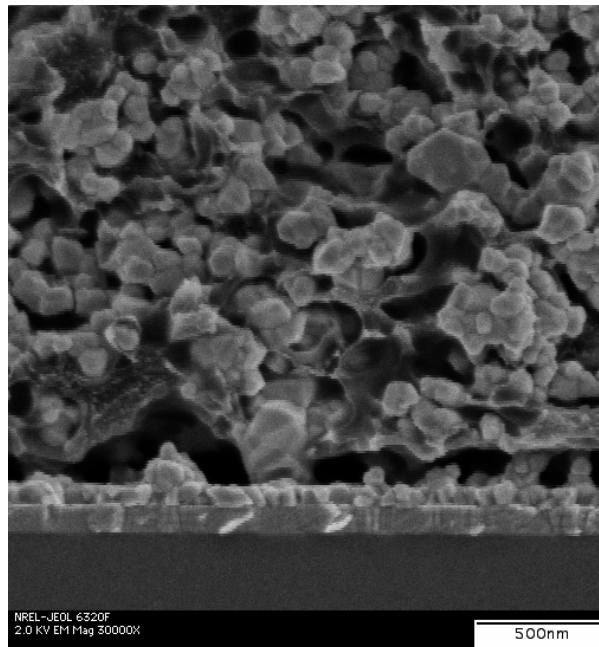
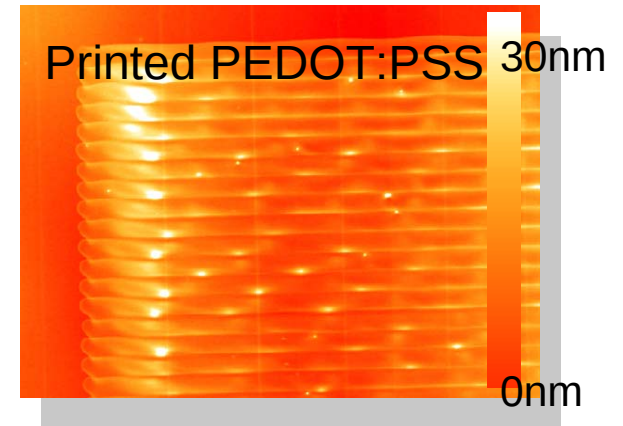
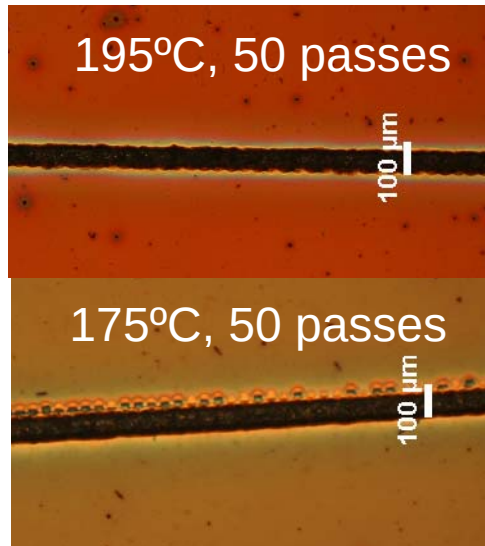
- CdTe

Sprayed Absorber

CBD CdS

Sprayed Contacts

- And more...



NREL-JEOL 6320F
2.0 kV EM1 Mag 30000X

500nm

COLO MINES

SEI

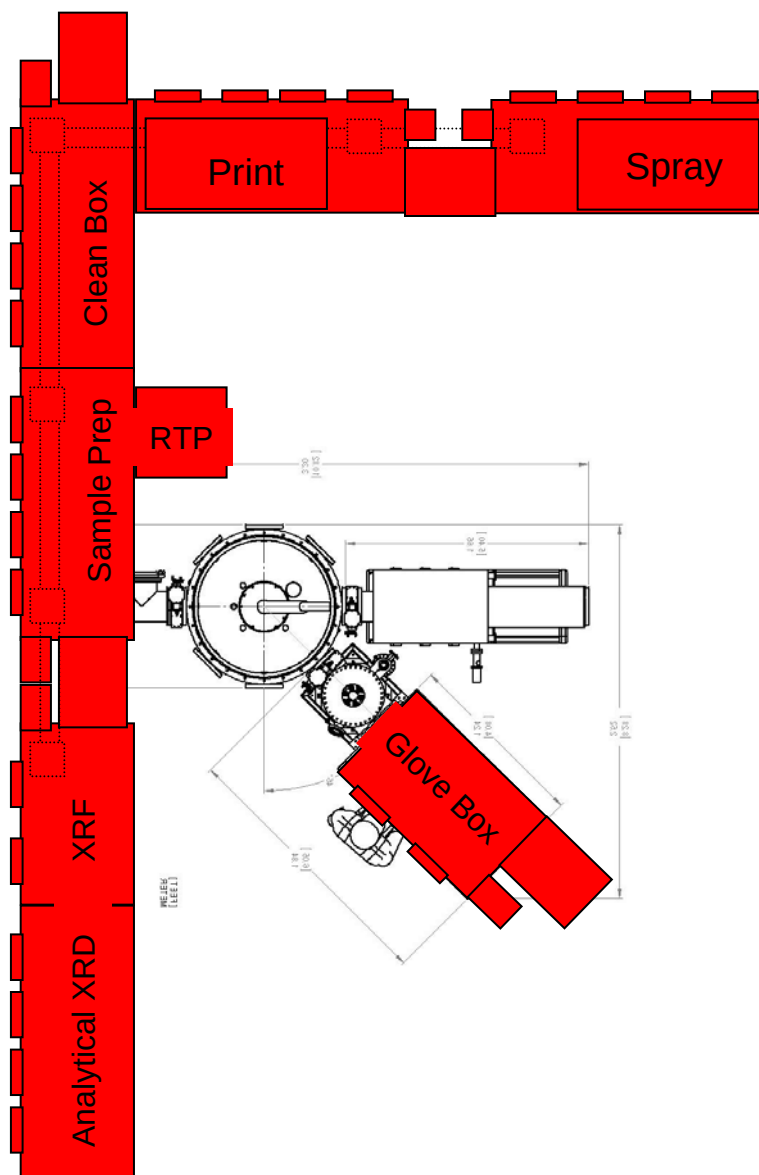
1.5kV

X6,000

WD 4.0mm

1 μm

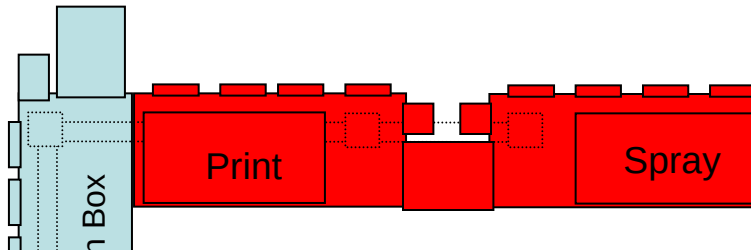
Glovebox system



Custom Gloveboxes by
Mbraun

Linear motion system for
sample transport between
boxes

Inkjet and Spray



Custom inkjet and spray
system by iTi

Build into glovebox

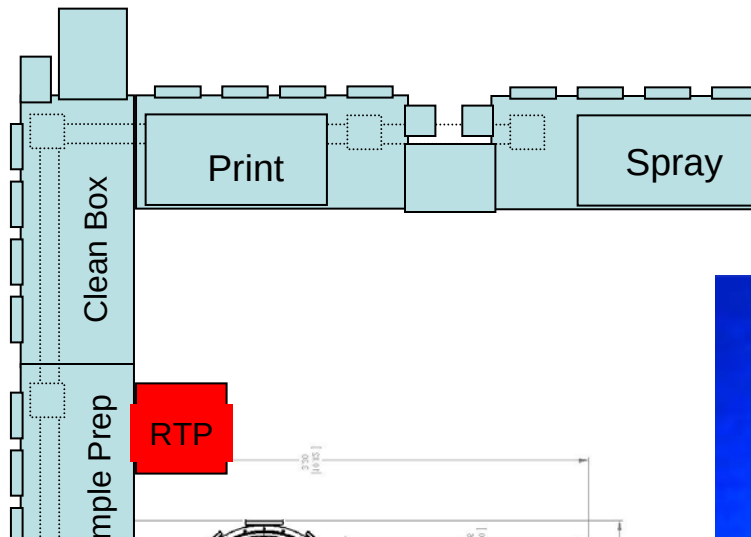
Universal X-Y platform

Multihead inkjet system

Multihead spray system

Systems interchangeable

Rapid Thermal Processing

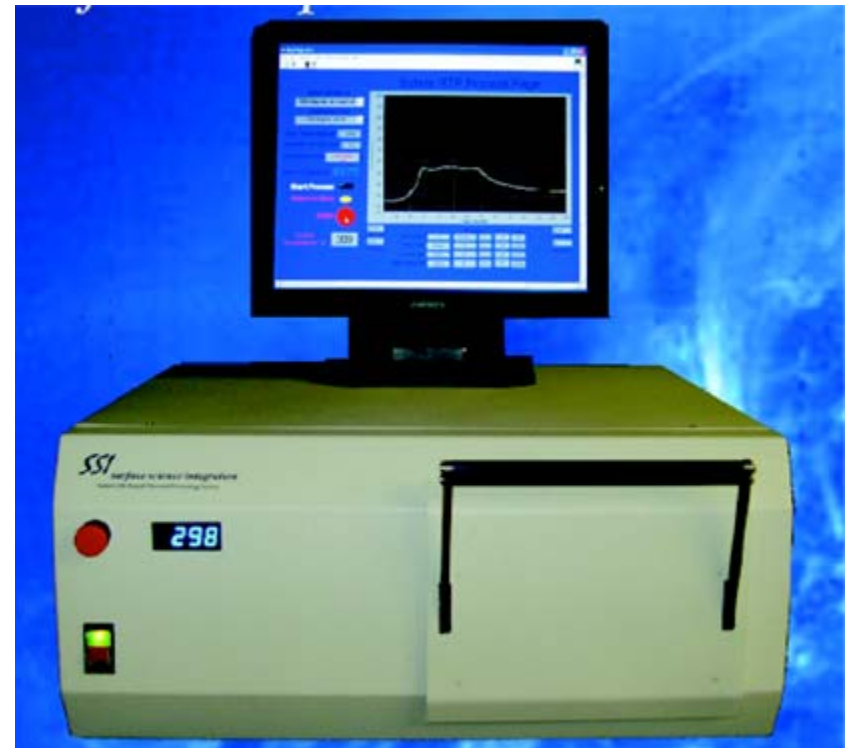


RTP by Surface Science
Integration

Build into glovebox

Up to 1250°C @ 150°C/s

3 process gasses



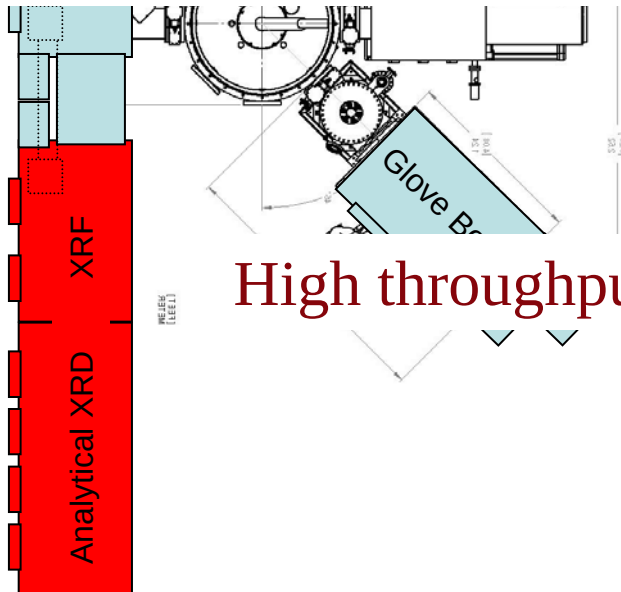
XRD and XRF

Compositional Analysis

XRF by Matrix Metrologies

Structural Analysis

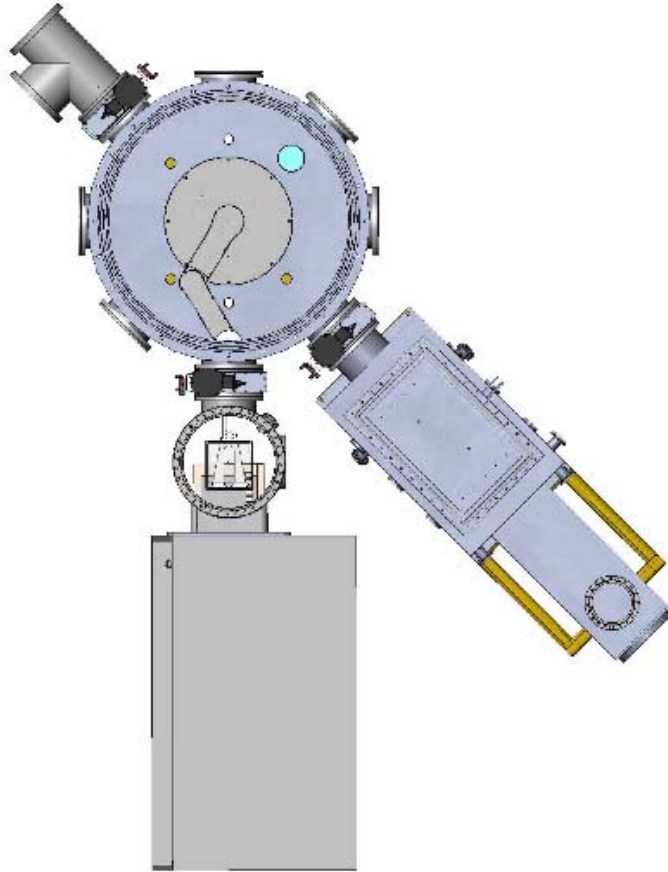
XRD by Bruker



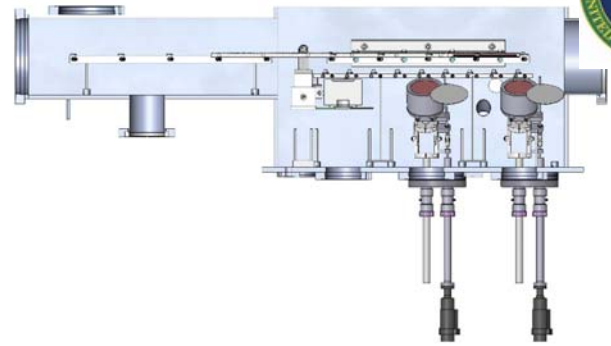
High throughput analysis



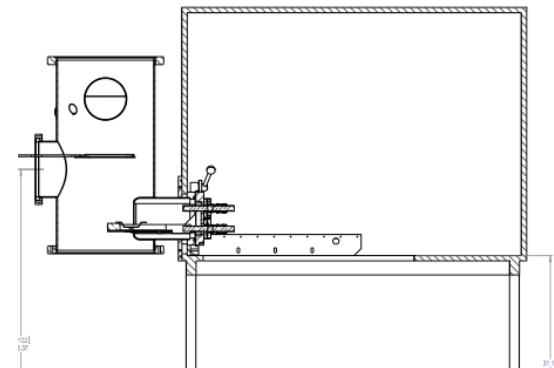
Vacuum Cluster



Cluster and chambers by
MVSystems



Multi source sputter chamber



Multi source evaporator
with glovebox access for
air sensitive materials



Atmospheric Processing Platform



- All major component have been ordered
- Estimated delivery major components: September-November
- Partial operation:
 - Glovebox system: November
 - RTP: November
 - Inkjet + Spray: December
 - XRD + XRF: December
 - Sputter + Evaporator: January 2009
- Full integrated operation: February 2009
- Interest from industry:
 - All current CRADA partners
 - Many others in all areas

M&C PDIL Capabilities

Pete Sheldon



Platform	PV Technology Road Maps						
	Wafer Si	Film Si	CPV	CdTe	CIGS	OPV	DSPV
Thin Si							
Wafer Rep.							
CIGS							
CdTe							
Atm. Proc.							
M&C Ind.							
M&C Cluster							