Objectives

- DSS and HEM functionality
- Growth of 60kG ingots PV-Si
# DSS SYSTEM COMPONENTS

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### Design Features

- 3 independent linear motion systems
- Double walled water cooled chamber
- Roots vacuum pumping system
- Argon gas overpressure control
- Mezzanine design for improved access
- DI water cooled electrodes
- Composite carbon insulation components
VERTICAL GRADIENT FREEZE
SYSTEM ADAPTED FOR CZT

Design Features

- 6-zone 5kW VGF furnace with Cd overpressure control
- Automated program for independent zone ramping
- Custom designed quartz pedestal for thermal coupling
- Linear translation and rotational capability
- In-situ monitoring and control over temperature gradients
WAFFER POLISHING FACILITIES

- Precision control over surface morphology
- Logitech PM5 System
- Logitech CP3000 Chemical Polishing System
Reproducibility

High electrical resistivity

Good grain size

Functioning gamma-ray devices tested

Small scale production developed

Wafer level electrode patterning

As Grown Crystals

50MM AS GROWN CZT USING VGF METHOD
VACUUM CARBON COATING OF QUARTZ/PBN CRUCIBLES

System Features

- Two zone 5kW furnace
- Automated process control
- Programmed temperature ramps
- Relay controlled valves
- Water cooled connections
- Vacuum & Argon gas pressure control

Carbon coated SiO$_2$

1-1.6 µm thick Quartz
CRUCIBLE DESIGN FOR PV-SILICON / CZT BULK GROWTH

Design Features

- **Silicon**
  - Succepetor design for Gen4 Quartz Crucibles
  - Custom lateral shields for thermal insulation
  - Molybdenum manifolds for increasing axial heat flow

- **CdZnTe**
  - Quartz glassware components designed
  - Custom etching protocol for crucible pairing
  - pBN crucible design
  - Carbon coating of pBN crucibles investigated
XEI-100 AFM used in this work for investigation of morphology of Cd(Zn)Te. (a) Z-servo motor, (b) light source, (c) microscope objective, (d) laser diode course and fine adjustment knobs, (e) AFM tip, (f) x-y scanning stage, (g) x-y servo motors, (h) photodiode, (i) laser diode, (j) AFM tip with, (k) sample surface.
COREMA system at CGL for non-contact measurement (a) open system, (b) system closed, (c) measurement probe, (d) sample stage/backside electrode.
Nikon 90i microscope used for IR transmission and epi-surface measurements. (a) ocular lens (b) objective turret and objectives (c) Frame (d) condensor lens (e) stage controller and focus wheel (f) light source (g) external camera.
ELECTRICAL CHARACTERIZATION: I-V, HOT PROBE

- Hot Probe
- I-V Characteristics

Left: 3D model of hot probe developed in CGL lab: (1) Teflon isolation (2) gold plated electrode (3) acrylic cantilever (4) magnetic mounting plate (5) resistance heating mount (6) retractable probe (7) resistance heater. Right: Hot probe measurement schematic.