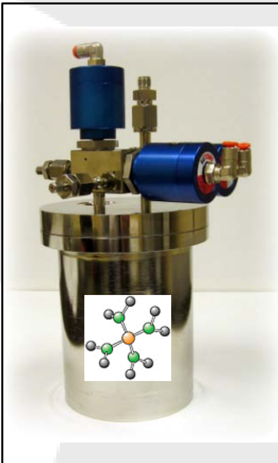
DLI-CVD and DLI-ALD of Hafnium oxide

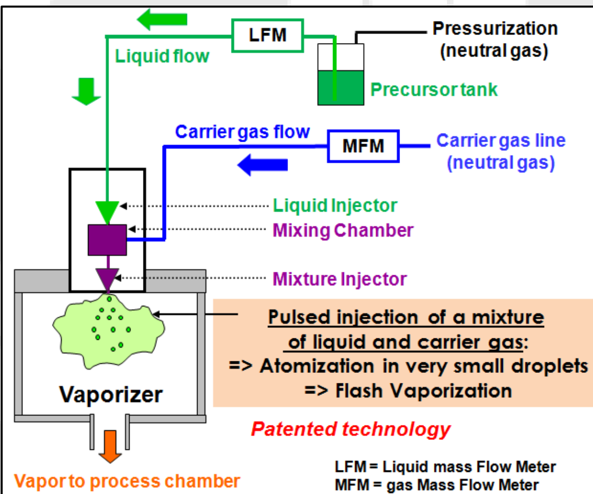
Turn-key equipment and process solutions



Chemicals and Handling

- **Tetrakis dimethylamino Hafnium:** Hf [N(CH3)2]4
- **Solution:** 0.05M in Octane solvent
- **Oxidizing agent:** O_2
- **Precursor tank:** Solution at room temperature
- **Liquid delivery panel:** Full rinsing capability
- **Precursor easy handling:** Full PC control

MC-100
DLI-SYSTEM



- Direct Liquid Injection technology:
  - Wide range of organometallic precursors available
  - Highest vaporization efficiency for CVD/ALD
- Precursor injection: Close loop pulsed gas flow
  - Precise and reproducible precursor flow control
  - Fine control of the material stoichiometry
- Resistive rotating substrate holder:
  - Precise control of the temperature from RT to 850°C
  - Position adjustment in the reactor chamber
- Automatic process control: Full data logging
- Remote operation: Industrial PLC and TCP/IP com

Thermal CVD of HfO_2 film:

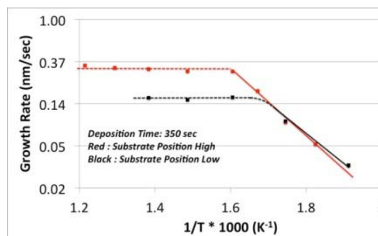
- Growth rate: : 0.32nm/s @ 400°C
- Kinetic control regime: 225-350°C
- Activation Energy: 65kJ/mol
- Relative Film density: 0.9
- Thickness uniformity on 4 inch: ≤ 2%
- Roughness : 0.8% of the film thickness
- Relative dielectric permittivity: 18

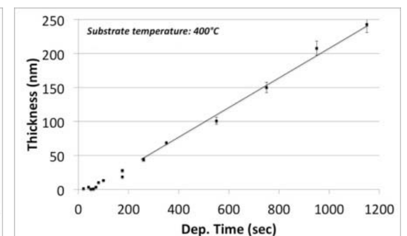
XPS:

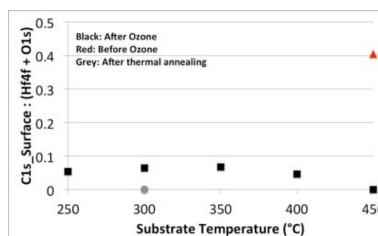
- C contamination < 0.1%
- N contamination: below limit detection
- Hf / O: 1.8

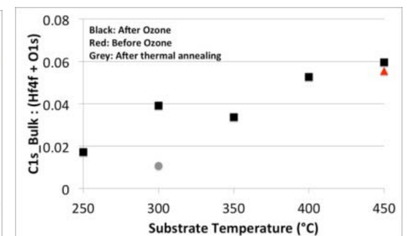
XRD:

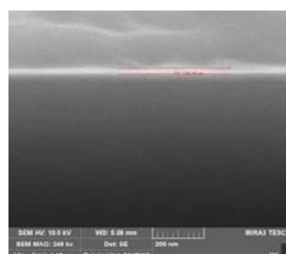
- 450°C Monoclinic phase
- 400°C Polycrystalline
- 300°C Nano crystallisation
- 250°C Amorphous film

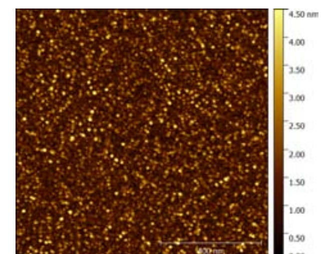












For more information contact Annealsys: contact@annealsys.com – www.annealsys.com

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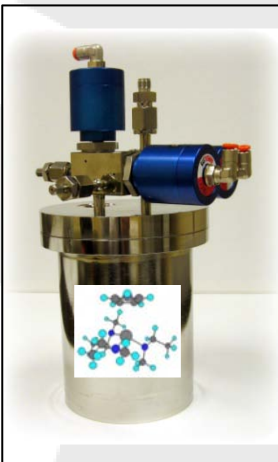
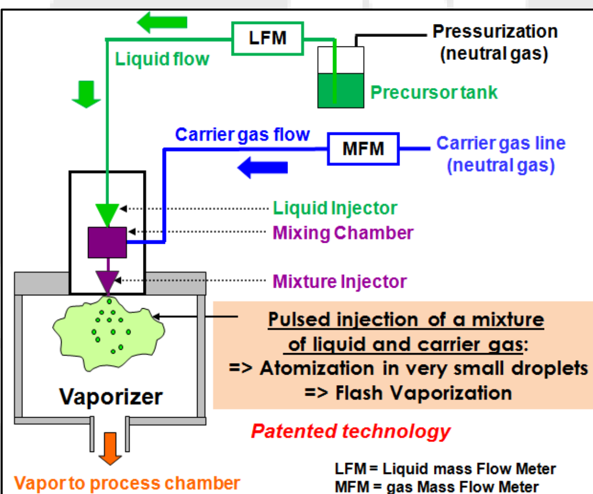
Turn-key equipment and process solutions



Chemicals and Handling

- **Tris-dimethylamino Cyclopentadienyl Hafnium:** CpHf $(NMe_2)_3$
- **Solution:** 0.05M in Cyclohexane solvent
- **Oxidizing agent**: H_2O
- **Precursor tank:** Solution at room temperature
- **Liquid delivery panel:** Full rinsing capability
- **Precursor easy handling:** Full PC control

MC-050
DLI-SYSTEM



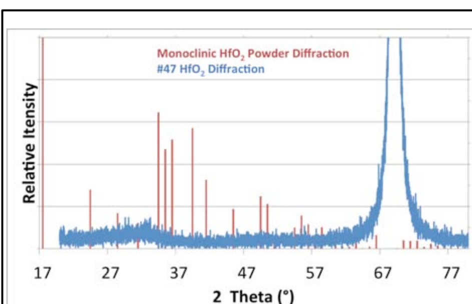
- Direct Liquid Injection technology:
  - Wide range of organometallic precursors available
  - Highest vaporization efficiency for CVD/ALD
- Precursor injection: Close loop pulsed gas flow
  - Precise and reproducible precursor flow control
  - Fine control of the material stoichiometry
- Fast response heater: Infrared halogen lamp furnace
  - Precise control of the temperature from RT to 1100°C
  - In situ pre and post RTP deposition processes
- Automatic process control: Full data logging
- Remote operation: Industrial PLC and TCP/IP com

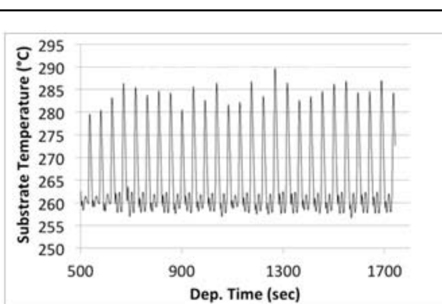
HfO_2 Thermal ALD film:

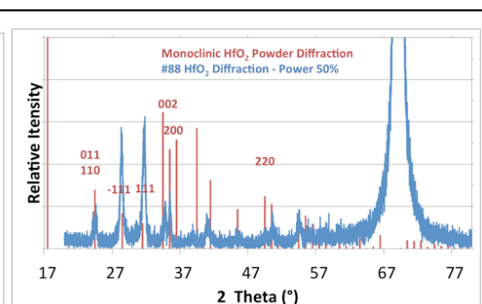
- Hf injection time/purge time: 20ms/15s
- H_2O injection time/purge time: 0.1s/10s
- GPC: 0.4 Å / Cycles @ 260°C
- Relative Film density: close to 1
- Thickness uniformity on 2 inch: ≤ 2%
- Roughness : 2nm
- Carbon contamination: < 1.5%
- Hf / O: 1.9
- Crystallinity: Amorphous

HfO_2 Pulsed Power ALD film:

- Hf injection time/purge time: 20ms/15s
- H_2O injection time/purge time: 0.1s/10s
- GPC: 1.1 Å / Cycles @ 260°C + flash power
- Relative Film density: close to 1
- Thickness uniformity on 2 inch: ≤ 2%
- Roughness : 2nm
- Carbon contamination: < 1.5%
- Hf / O: 1.9
- Crystallinity: Monoclinic







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