Model-Based Temperature/CD Tuning of Multi-Zone Heated Plates

Dick de Roover, Abbas Emami-Naeini, Narasimha Acharya,
Jon L. Ebert, La Moyne Porter II

SC Solutions, Inc.
1261 Oakmead Pkwy
Sunnyvale, CA 94085
Email: roover@scsolutions.com

APC Conference XXVIII 2016
Phoenix, AZ
Oct. 17-20, 2016

SC SOLUTIONS
Value Through Innovation

Overview

- ❑ **Multi-zone Heated Plates**
- ❑ **Model-based Tuning Approach**
- ❑ **Simulation Results**
  - o ***Radial & Azimuthal non-uniform profiles***
  - o ***Effect of Measurement Points***
  - o ***Effect of Measurement Noise***
- ❑ **Summary & Conclusions**

Multi-zone Heated Plates

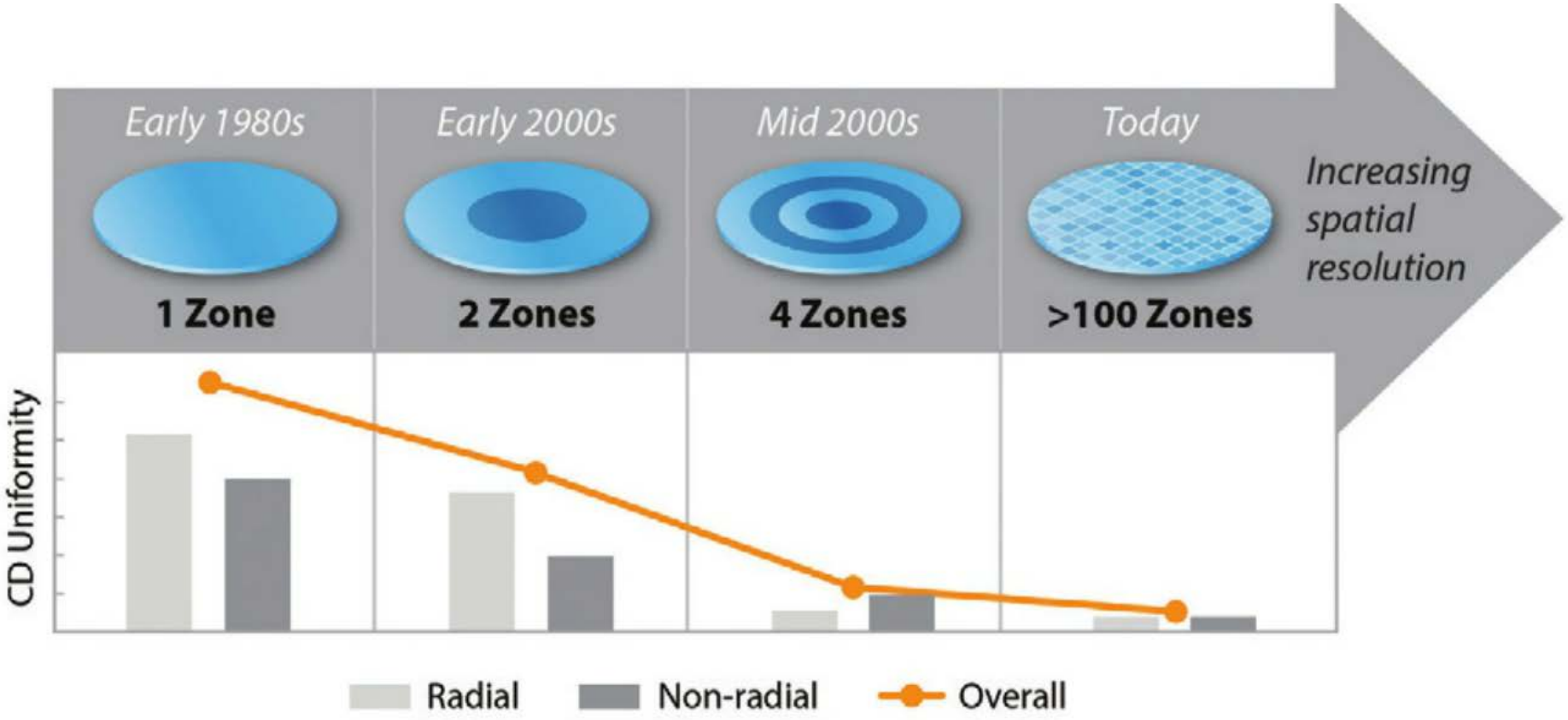
- **Heated Plates play an important role in many processes in the Semiconductor industry**
  - ***Plasma etch***
  - ***CVD***
  - ***Post-Exposure Bake (Track)***
  - ***And others …***

- **Controlling plate temperature uniformity has become increasingly important**
  - ***Plate temperature uniformity has a direct impact on wafer temperature uniformity and corresponding yield***
  - ***Over the years, the number of plate actuators and sensors has increased to allow for finer and more uniform temperature control and tuning***

- **As a result, plate temperature control and corresponding temperature offset tuning have become increasingly complex**

A systematic tuning approach is needed

Evolution of Multi-zone Heated Plates



Source: Solid State Technology, July 2016, Vol. 59, No. 5

Overview

- Multi-zone Heated Plates
- **Model-based Tuning Approach**
- Simulation Results
  - *Radial & Azimuthal non-uniform profiles*
  - *Effect of Measurement Points*
  - *Effect of Measurement Noise*
- Summary & Conclusions

Model-Based Tuning Approach

- A Model-Based Tuning (MBT) approach has been developed
  - *Based on accurate heat transfer models of multi-zone plates*
  - *Models are integrated with state-of-the-art constrained optimization methods*
  - *The result is a systematic data-driven tuning method providing optimal uniformity*
  - *This tuning method provides a custom solution for each unique plate*

- For this research, four different plate models were developed:
  - *5-zone axi-symmetric plate*
  - *33-zone plate*
  - *64-zone plate*
  - *133-zone plate*

- The following fab-realistic simulations were performed for each plate:
  - *Different initial non-uniform profiles (radial, azimuthal non-uniformity)*
  - *Different number of measurement points (temperature vs. CD)*
  - *Different noise conditions*

- Performance plots are shown for each case

Contact

Full Presentation is part of the APC 2016 proceedings.
Please contact SC Solutions if you would like to
receive a full copy of this presentation.

Dick de Roover
roover@scsolutions.com