April 3 - April 4, 2006, Tower Hotel

Key Issues of the UV-Nanoimprint Equipment for sub-50nm Half-pitch Patterns

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Outlook

- Introduction
- Key Issues
  - Uniform Contact Imprinting Mechanism
  - Overlay & Alignment System
  - Stamp Fabrication
  - Anti-Vibration System
  - UV-NIL Tools ANT-4
  - Experimental Results
- Conclusions

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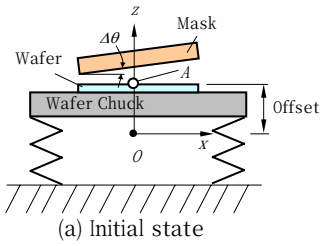
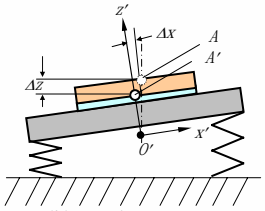
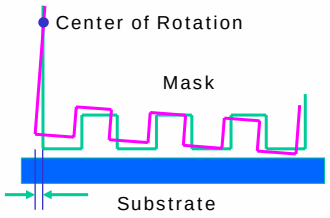
Uniform Contact Imprinting Mechanism



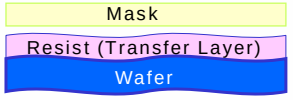
(a) Initial state



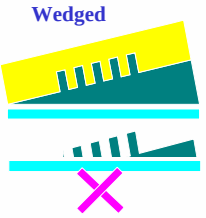
(b) Final state

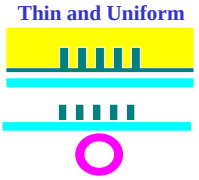


Imprinting Errors
(Wedged Pattern)



Surface Non-Uniformity

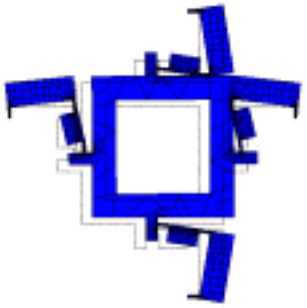


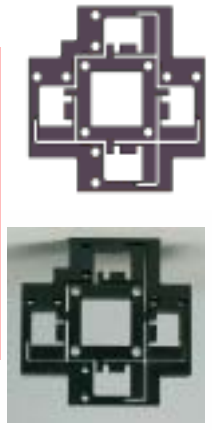


Modal Analysis : Planar Motion Mechanism

Nanopositioning Mechanism

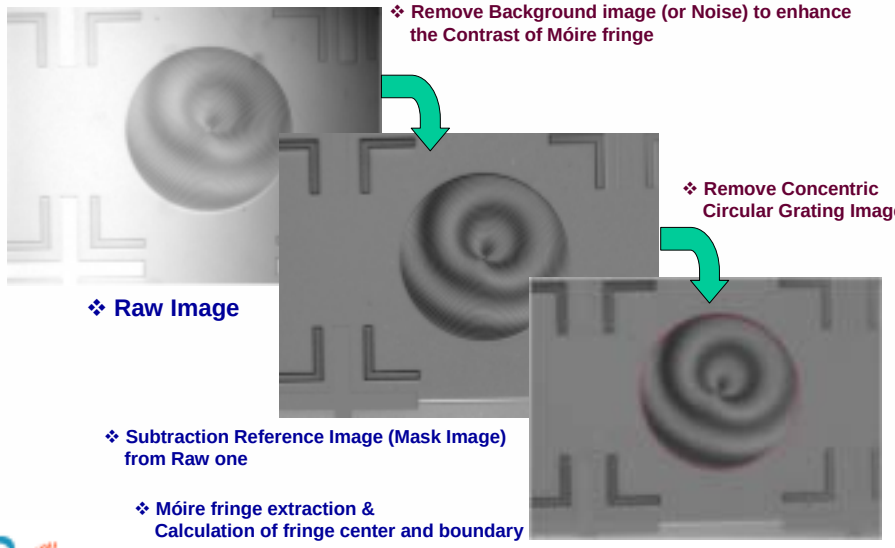

Rotation: 760 Hz


Translation: 834 Hz


Manufactured Planar Motion Mechanism for Nanopositioning

3 DOF : 2 Translation and 1 Rotation

1st Alignment : Moire Fringe Analysis (1)



❖ Remove Background image (or Noise) to enhance the Contrast of Móire fringe

❖ Remove Concentric Circular Grating Image

❖ Raw Image

❖ Subtraction Reference Image (Mask Image) from Raw one

❖ Móire fringe extraction & Calculation of fringe center and boundary

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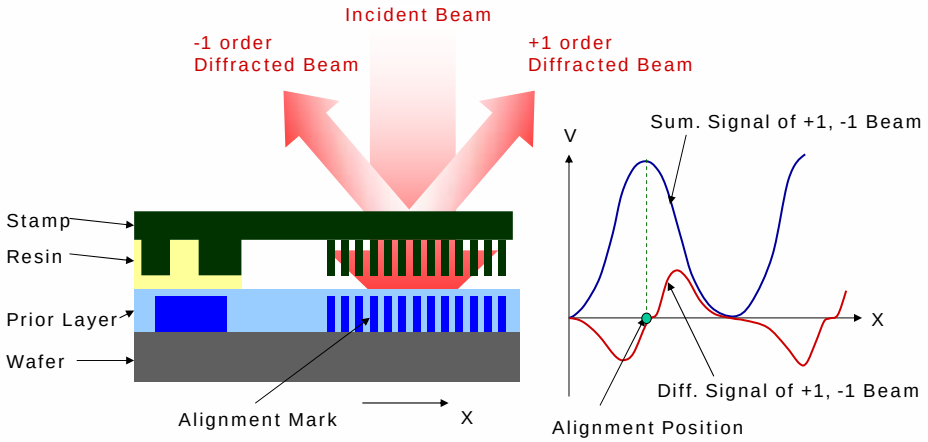
2nd Fine Alignment : Dual Grating



Fine Alignment : within One Period of Grating

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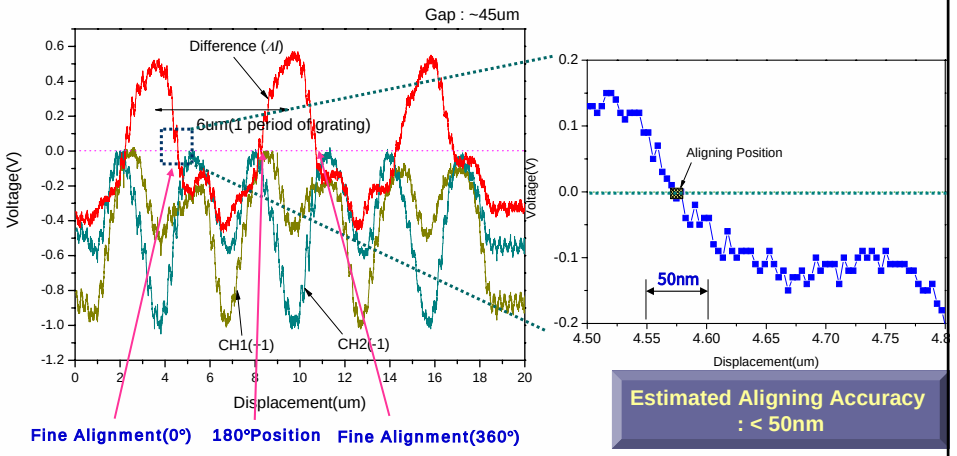
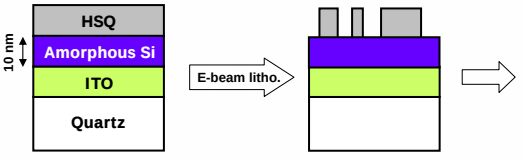
Aligning Signal by Dual Grating



Estimated Aligning Accuracy : < 50nm

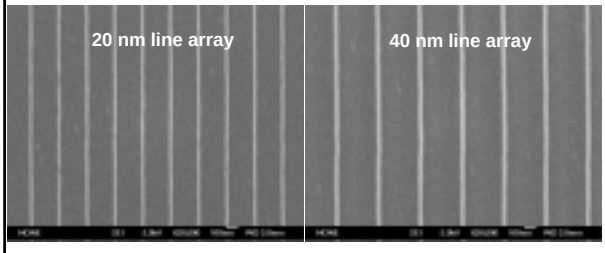
Quartz Stamp Fabrication for UV-NIL (2)

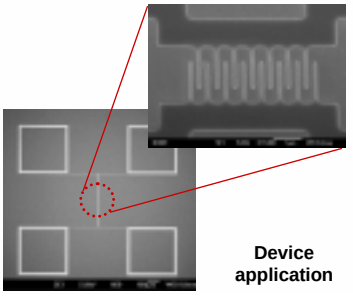
Resolution & Chemical stability



Pirana solution test
: H_2SO_4:H_2O_2 4:1
: 10 min dipping

After Pirana solution test ,





Device application

UV-NIL Tools with Multi-Head Imprinting Unit

50nm UV-NIL : ANT-4

Sub-50nm UV-NIL : ANT-6

- Imprinting Conditions
  - Wafer : 4 inch
  - Imprinting Pressure ≤ 2bar
  - Single Layer / Single Step
- Imprinting Head
  - Chip-size Multi-Head Type
  - Multiple Chucking System
  - Variable Pressure Type
- XYZ Stage
  - Stroke : 120 x 250 x 25mm
  - Z Sliding Unit
- UV System
  - ≥ 50mw/cm^2
  - Power supply : 2Kw
- Anti Vibration System
- Controller : UMAC-2

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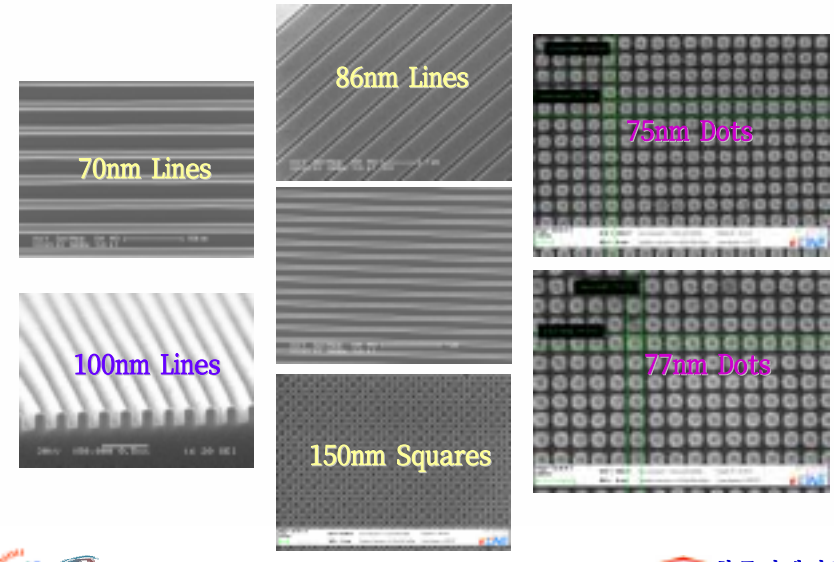
Experimental Results using ANT-4 (1)



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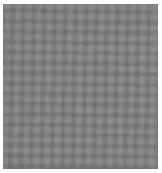
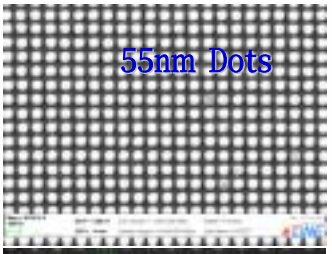
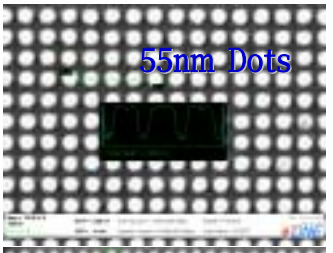
Experimental Results using ANT-4 (2)

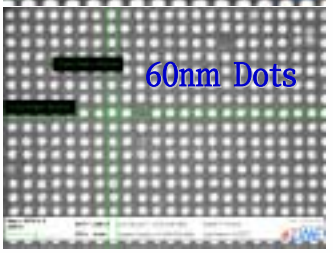


50nm
Stamp

NIP-K40
Spin coat







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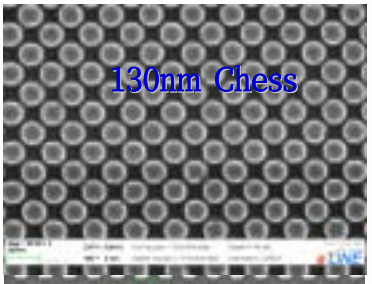
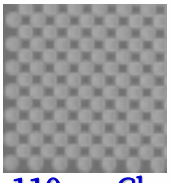
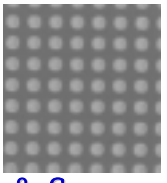
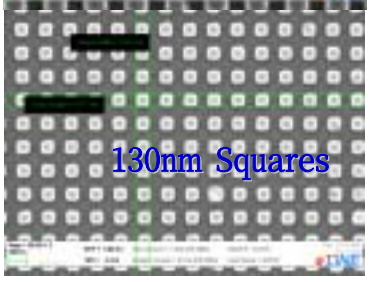
Experimental Results using ANT-4 (3)

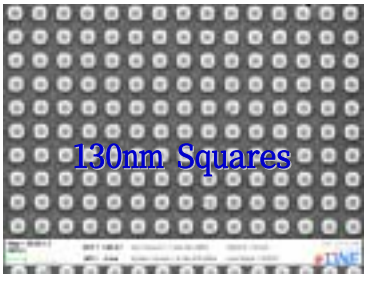






110nm Chess & Square





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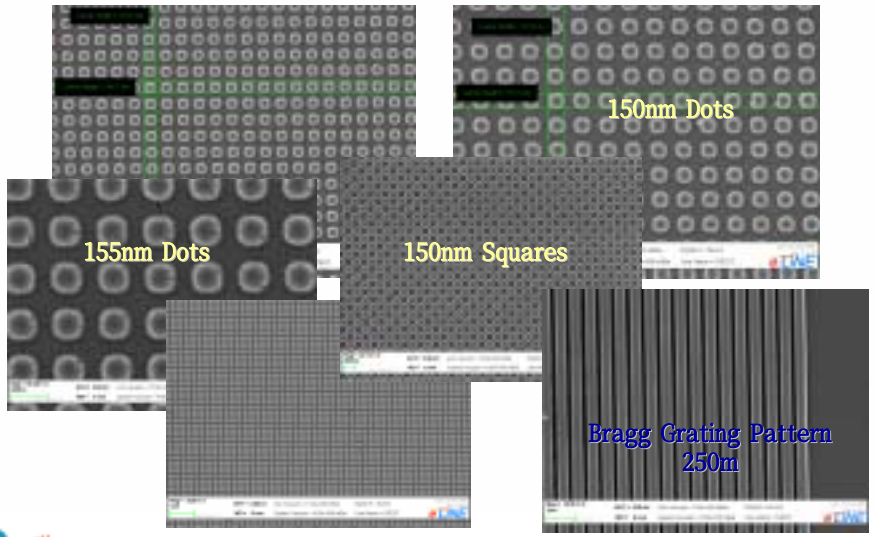
Experimental Results using ANT-4 (4)



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Thanks for
your attention!

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