
Immersion Fluid Fundamentals Introduction

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 - Satish Kandlikar

Status at July 2003 Workshop

- **Possible show-stoppers**

- None

- **Probable small effects**

- Thermal aberrations from liquid heating
- Nano-bubbles: requires de-gassing
- Liquid Rayleigh and Raman scattering
- Water-fused silica interactions

**Primary focus
since July**



- **Need further study: solutions appear feasible**

- Control of micro-bubbles
- Resist outgassing (bubble formation and contamination)
- Forces on optics
- Water interaction with CaF_2 & coatings

Immersion Fluid Fundamentals

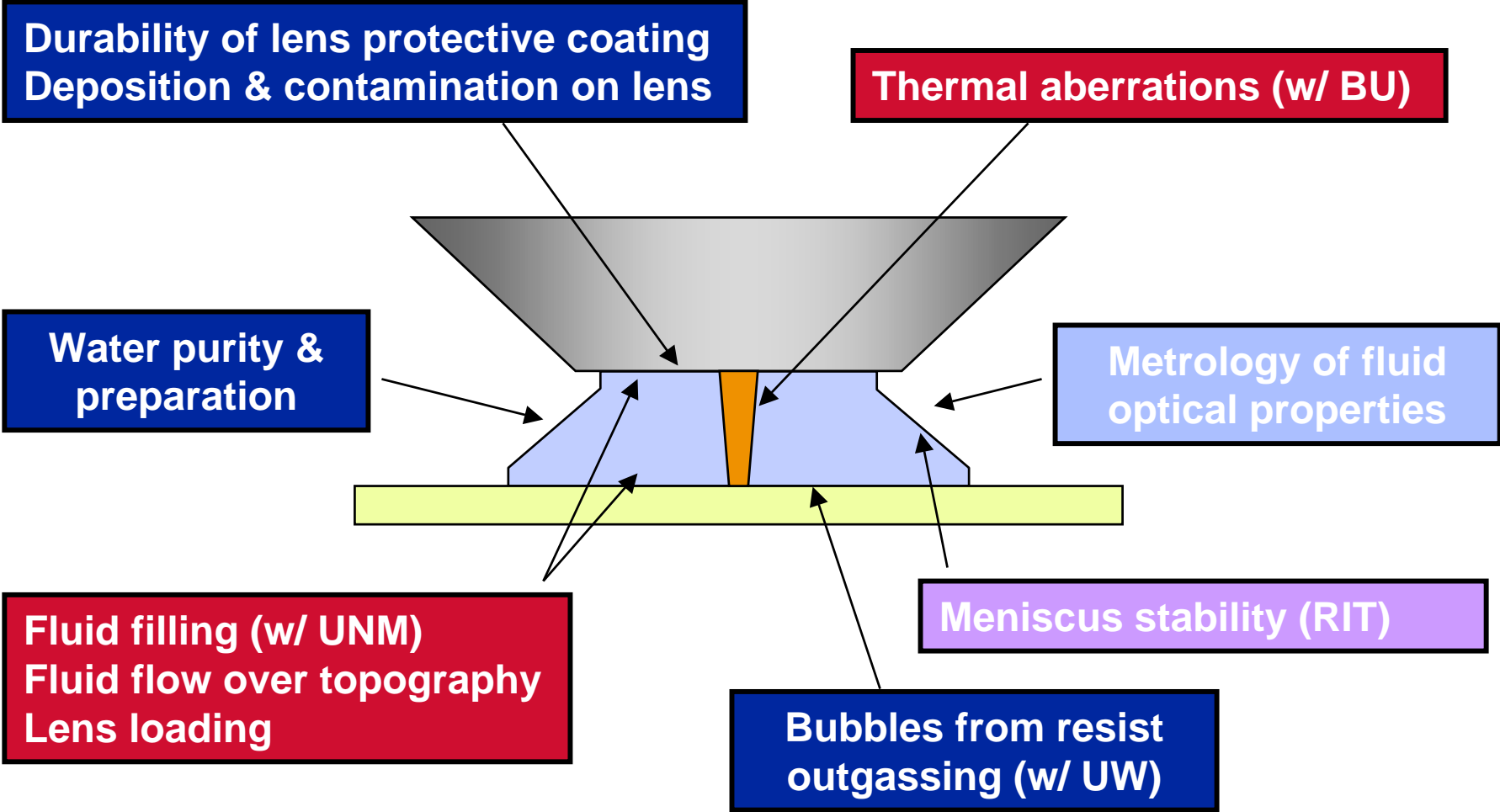
- **Objective**

- Create knowledge base to assess critical issues related to immersion fluids and surface interactions

- **Approach**

- Perform directed research at universities and national labs
- Projects selected based on needs of exposure tool and resist suppliers

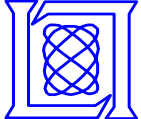
Immersion Fluid and Interfaces



UW-Madison
Computational
Mechanics Center



R-I-T



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Mapping to Critical Issues

1. **Defect formation, control, and characterization – e.g., droplet in wrong place, topography, or entrainment from jets – new defect types**
2. **Hyper NA complexity and reticle polarization constraints including impact on: field size (lens complexity), reduction ratio, RET, and simulation tools.**
3. **Robust CaF₂ protective layer for bottom element, including laser durability, contamination/erosion susceptibility**
4. **Specification and preparation of water, including: absorption control, surface tension & wettability, and ESD**
5. **Influence of fluid on resist, resulting in altered process properties (e.g., swelling).**
6. **Timing versus infrastructure versus competing technologies, extensibility**
7. **Chemical contamination of fluid by resist which impacts imaging through altered fluid optical properties on time scale of exposure**
8. **Edge Die Exposure**
9. **Thermal management of fluid**
10. **Experimental data (early tool access)**

5 critical issues in red addressed in this session

Presentations

- **Topology, filling, lens loading**
- **Bubble creation/reduction**

- **Lunch**

- **Water for immersion lithography**
- **Fluid refractive index metrology**

Alex Wei & Greg Nellis

Satish Kandlikar

Mike Switkes

John Burnett