Design and Testing of a Robust Platform For Nanofluidic Separations

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Goal: Portable Nanofluidic Separation Devices

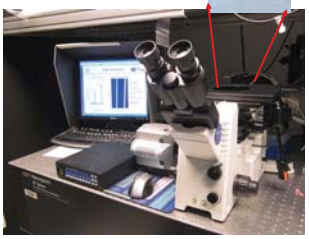
- Biomolecule analysis: a tool for diagnosis, biometric fingerprinting, forensics,….
- Push towards lower analysis time for faster response
- Current technology not suited for field-deployable devices
- Nanofluidic technology can offer a valuable alternative

Today: "Chip in a Lab"

Characterization is done in a laboratory environment. Nanofluidic chip needs to interface standard laboratory equipment:

1. Inverted microscope, Olympus IX71
2. High speed CCD camera, Andor iXON
3. High voltage supply, LabSmith HVS448
4. Fluorescence excitation by Hg lamp

Nanofluidic chip, 45mmX15mmX1mm



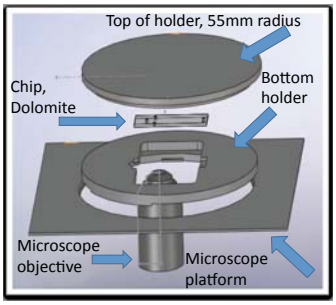
Chip Holder Design

Design constraints:

- Bottom Piece
  - ➢ Compatibility with microscope
  - ➢ Precise positioning of chip
  - ➢ Dimension tolerances of chips
  - ➢ Non-interfering with oil objective
- Top piece:
  - ➢ Non-conductive
  - ➢ No reflection
  - ➢ Reservoirs (→ sealing)

Software design tool: SolidWorks
Features used: assembly, interference detection, mate, animation.

Simulation of lab set-up using SolidWorks



Early Designs

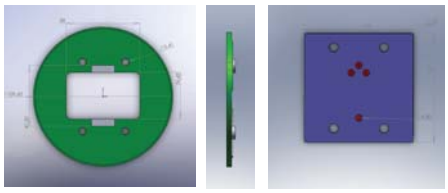
Bottom piece:

- Difficult to machine
- Not good grasp of chip
- No flexibility for size tolerances

Top piece:

- Unnecessarily more expensive to machine

Final Design

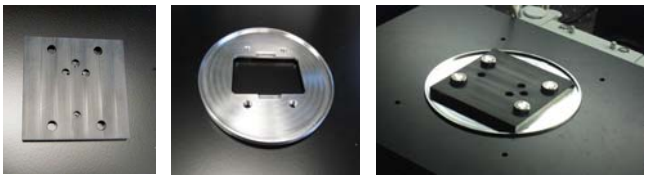


- ✓ Bottom piece: aluminum → flatness and robustness.
- ✓ Extrusions to avoid rotation
- ✓ Springs to adjust for different size chips
- ✓ Open in the center region for objective accessibility
- ✓ Top piece: Delrin → non-reflecting and non-conductive.
- ✓ Reservoirs with o-rings for sealing

Testing

Performed electrokinetic injection experiments:
→ most design requirements successfully satisfied
→ leak observed after few minutes from start of experiments
Possible causes and countermeasures:

1. o-ring material too hard
2. Incorporate a support all around chip perimeter



Conclusions & Future Directions

Designed first prototype for nanofluidic chip-holder. Holder satisfies all design constraints, but leaking observed during testing shows need to improve design.

Acknowledgements

Inset: Nick Arnold, Jens Kuhn, Ofelia Aguirre
UCSB: Maria Napoli, Sumita Pennathur, Nanolab, COE Machine Shop, CNSI