Direct on-chip storage and release of liquid reagents for diagnostic lab-on-a-chip devices

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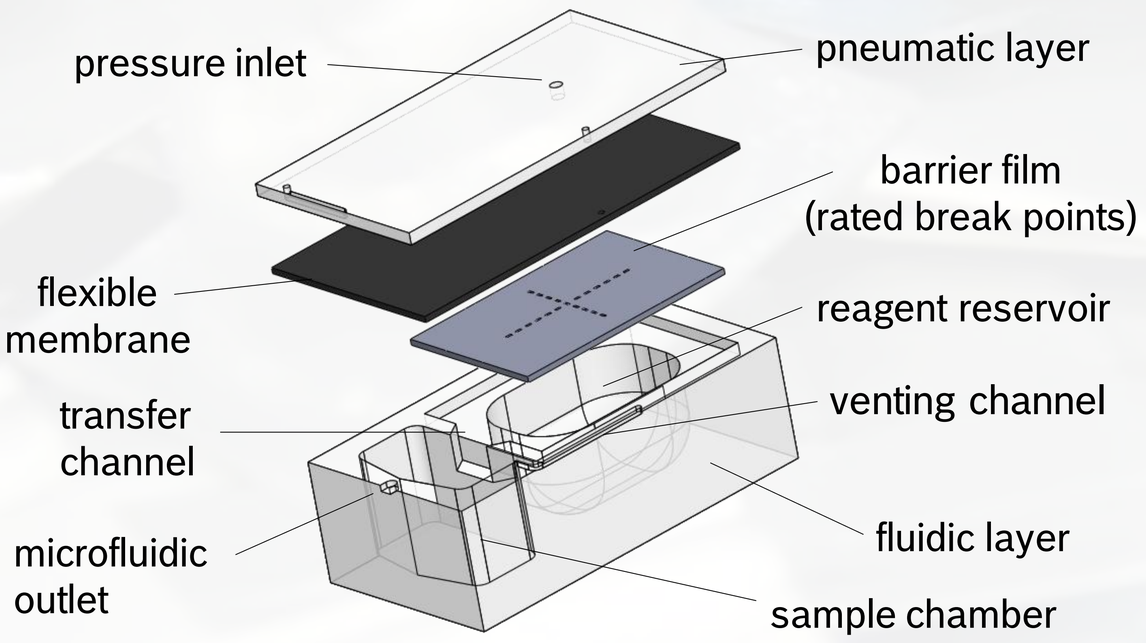
Introduction

- On-chip reagent storage[1] is essential for the commercialization of lab-on-a-chip (LoC) platforms, e.g. storage in glass ampoules[2] or stick packs[3].
- Since these concepts implicate manufacturing complexity, direct on-chip storage of liquid reagents in reservoirs is preferable.
- Here, we present a **direct on-chip storage of reagents**. Reservoirs are made of high barrier polymers[4] (e.g. PP, PE, COP, COC) and sealed with a standard barrier film.
- Reagent release is realized by braking up the barrier film through a deflection of a flexible membrane. Stored reagents get displaced in a sample chamber for further processing.

Reagent storage in a polymer multilayer stack



Operation mode of reagent release

Initial state (cross section)
- No pressure applied

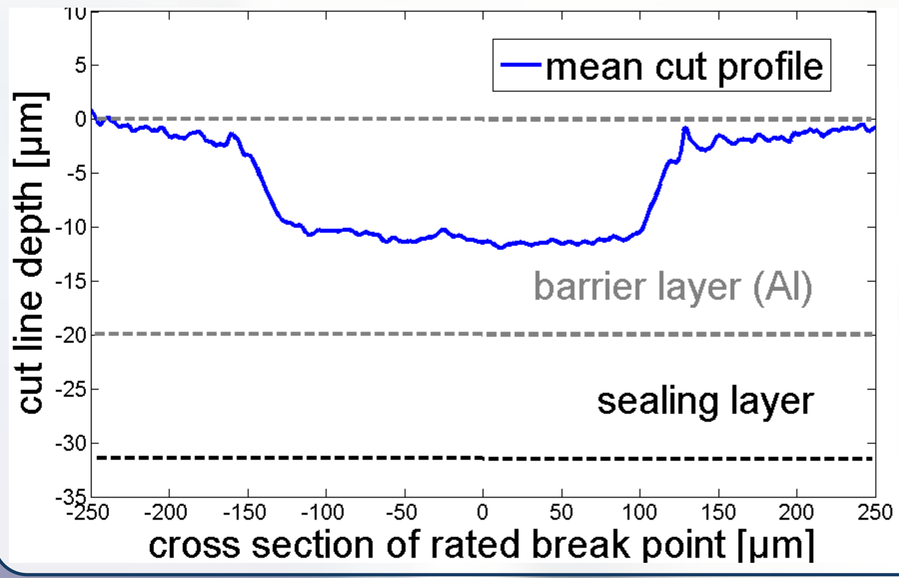
Pressure actuation
- Deflection of flexible membrane

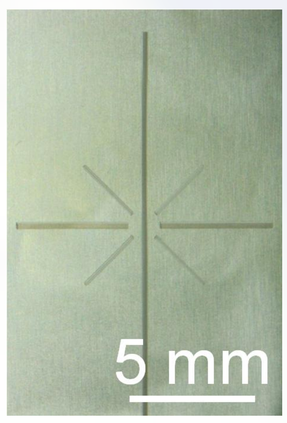
Breaking up the barrier film
- Tearing starts at rated break points of the barrier film

Reagent release
- Stored reagent is transfered to sample chamber for further microfluidic processing

Predetermined rated break points in barrier film

- Implementation of rated break points by laser ablation
- Barrier properties of the aluminium layer remain unaffected





Results

- Test device including 3 adjacent reagent reservoirs
- Reagent: water (V = 500 µl)
- Pressure actuation of the membrane with P_a = 2 bar
- Reagent release and collection in sample chamber after 5 s
- Efficient recovery of prestored volume due to highly elastic properties of the membrane

t_1 = 0 s | t_2 = 1 s | t_3 = 2 s | t_4 = 5 s

Conclusions

The presented concept provides a robust solution for reagent storage. It can be easily implemented into pressure driven LoC-platforms.

- **Reduction of manufacturing complexity:** Direct on-chip reagent storage enables lean LoC production lines
- **Footprint reduction:** Required space shrinks to a minimum compared to other LoC-storage concepts
- **Long-term storage:** Using high barrier polymers combined with standard barrier films enables long-term storage of liquids

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