Material Performance Testing for Blister Packs for Microfluidic Point-of-Care Systems

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Introduction:

- Blister packs provide sealed reagent storage, protecting against humidity and contamination for reliable point-of-care use
- Our current POC diagnostic device requires manual reagent injection; integrating an on-chip blister pack improves safety and usability by eliminating syringes
- Blister materials must be tested for chemical compatibility, barrier performance, and mechanical durability to ensure stable reagent delivery

Methods:

1. Design & Modeling: Blister pack and test chip modeled in SolidWorks.
2. Fabrication: Thermoformed blisters from different plastic materials using a vacuum former.
3. Integration & Testing: Mounted on POC cartridge and evaluated material strength, seal integrity, and reliability during actuation.

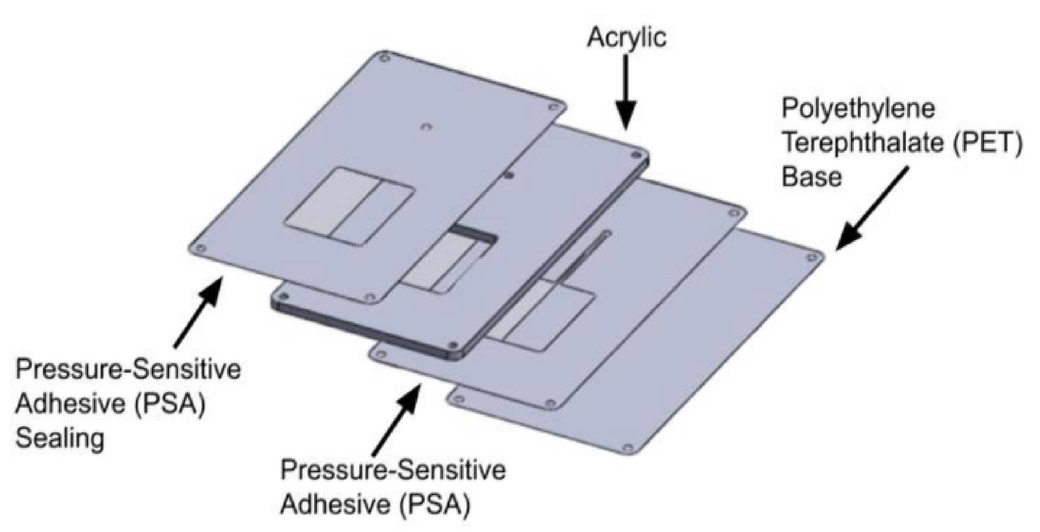

Figure 1. CAD Model of Test Chip. The test chip includes a total of 4 layers in the order of PET, PSA, acrylic, and PSA on top.

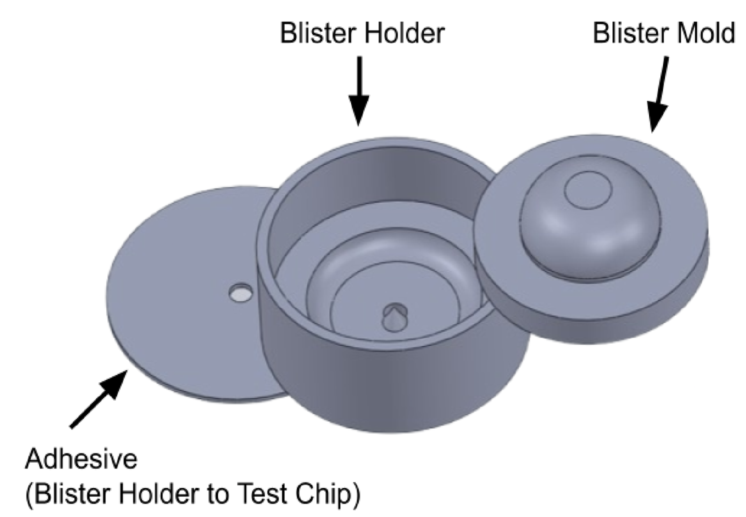

Figure 2. SolidWorks CAD model showing blister mold with cavity, holder, and adhesive.

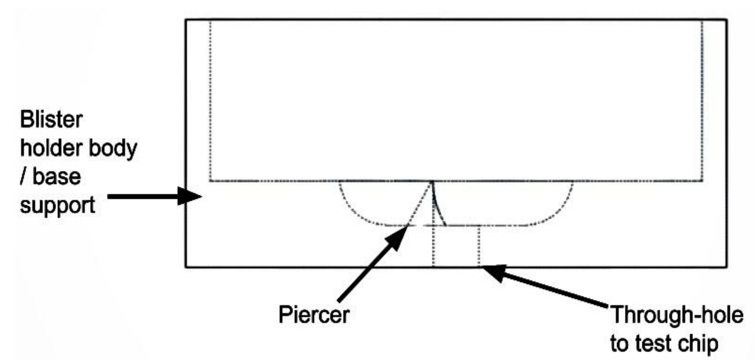

Figure 3. CAD Model of Blister Holder. The blister holder features a piercer meant to puncture the blister foil and release the liquid into the channel and well.

Figure 4. Thermoforming process. Top: PETG sheet heated to 75°C, pressed onto molds, and vacuum sealed. Bottom: cooled sheet removed, forming blister cavities.

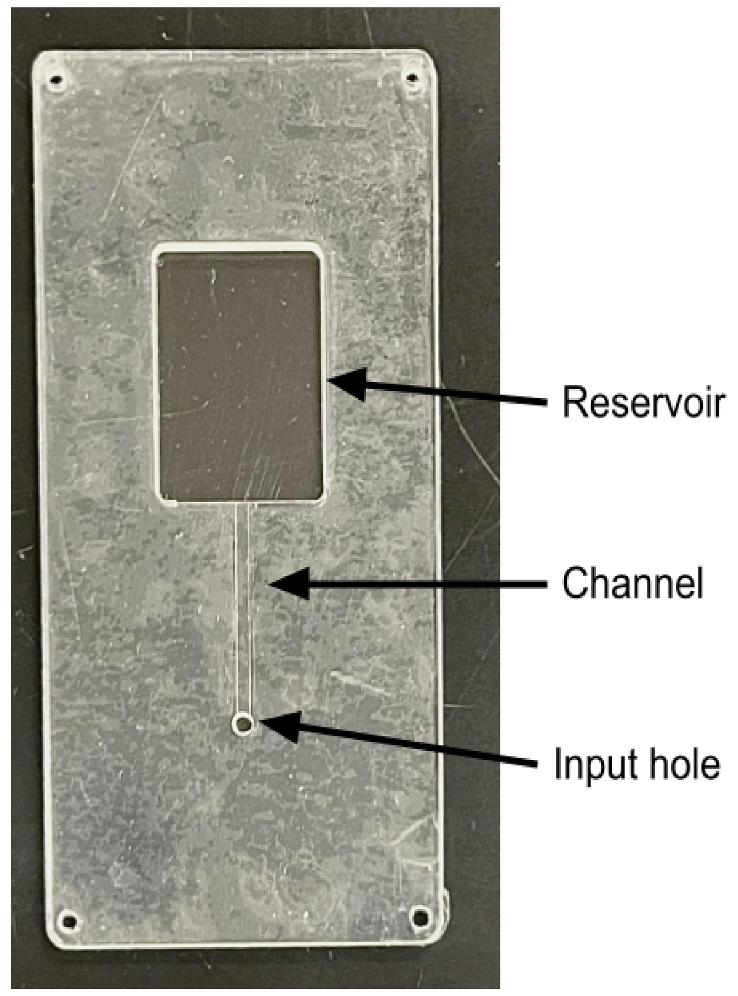

Figure 5. Test chip used for experimentation. Liquid enters through the input hole, flows through the channel, and collects in the reservoir.

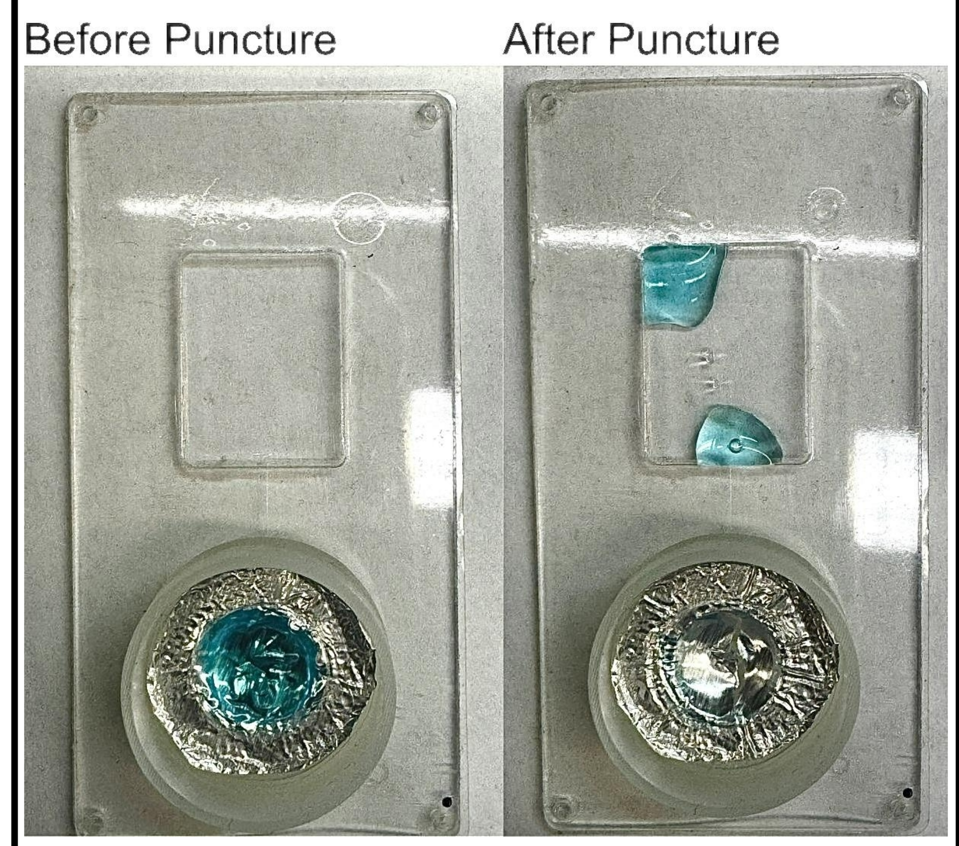

Figure 6. A representative trial of the blister puncture test. The blue colored water moved from the blister cavity to the reservoir in the chip.

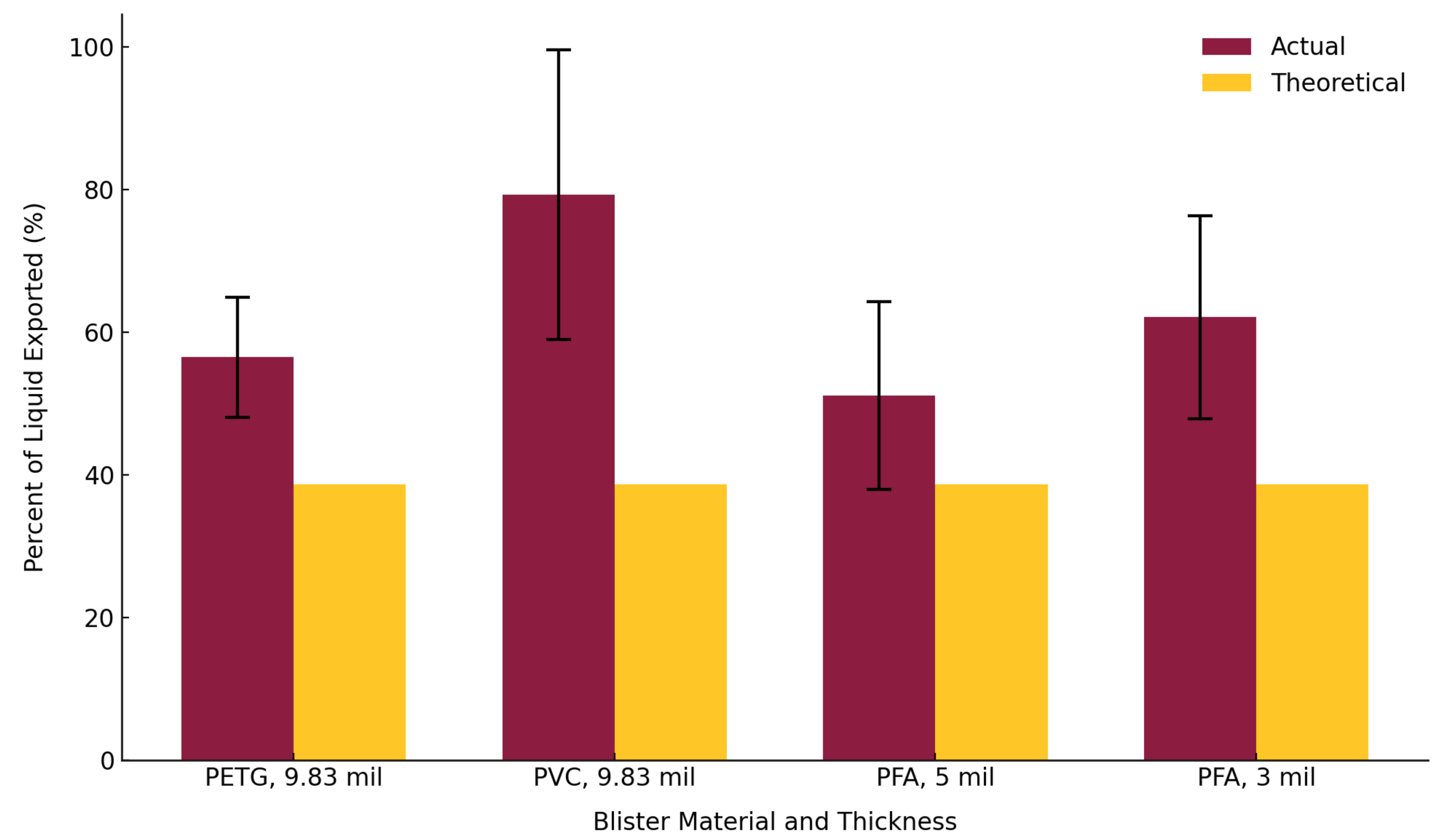

Figure 7. Percent of liquid exported from blister packs of varying materials and thicknesses compared to theoretical values. PVC (9.83 mil) achieved the highest average liquid export (79%), while PETG (9.83 mil) and PFA (3–5 mil) showed lower delivery efficiencies. Error bars represent standard deviation for n=5.

Results and Conclusions:

- PVC (9.83 mil) achieved the highest liquid export (~79%), indicating optimal flexibility and sealing for consistent reagent delivery.
- PETG and PFA materials showed lower and more variable performance (≈55–65%), likely due to higher stiffness or incomplete deformation.
- Thinner PFA (3 mil) improved export efficiency compared to thicker samples, suggesting material thickness directly affects actuation performance.

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