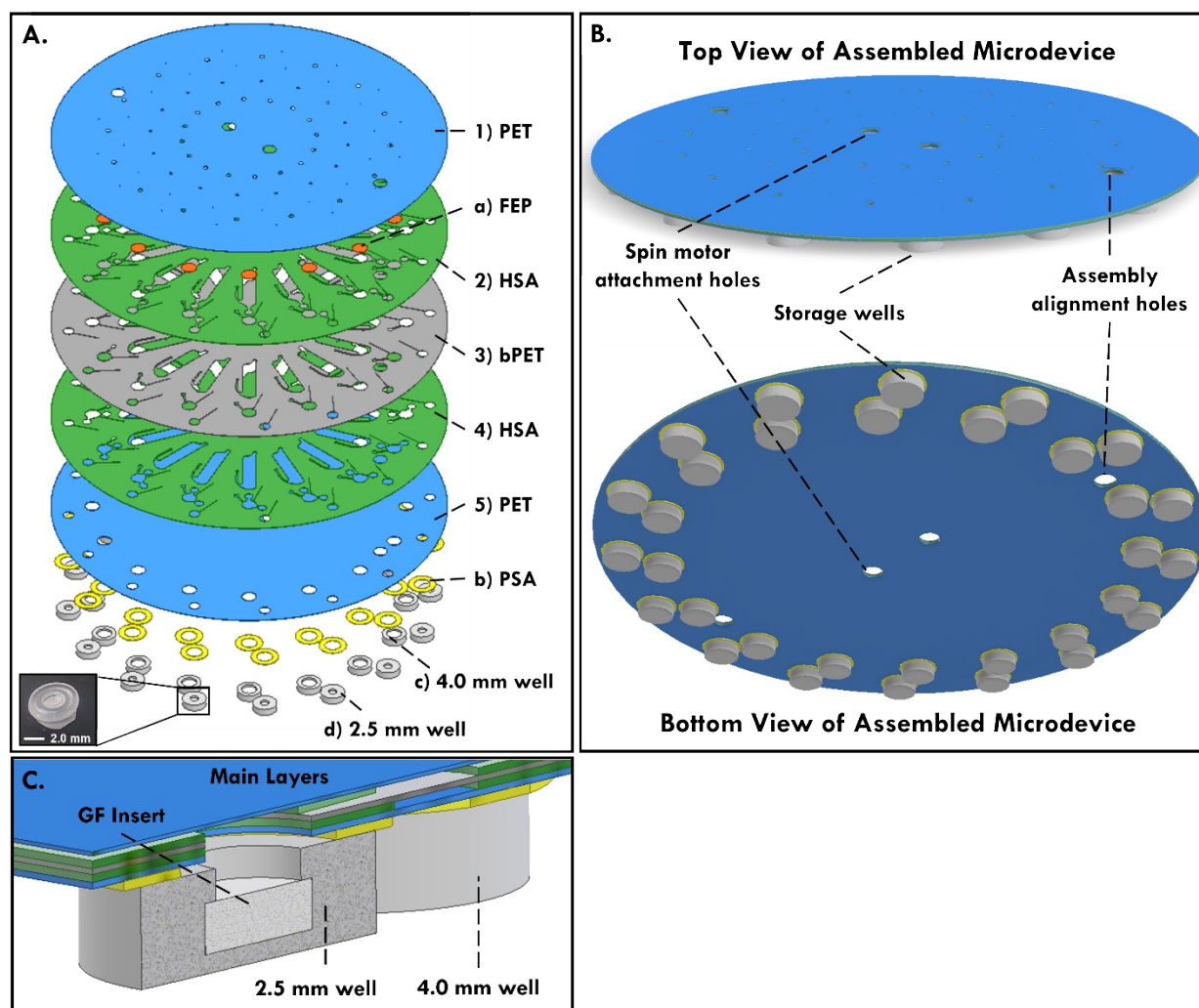


Supplementary Information

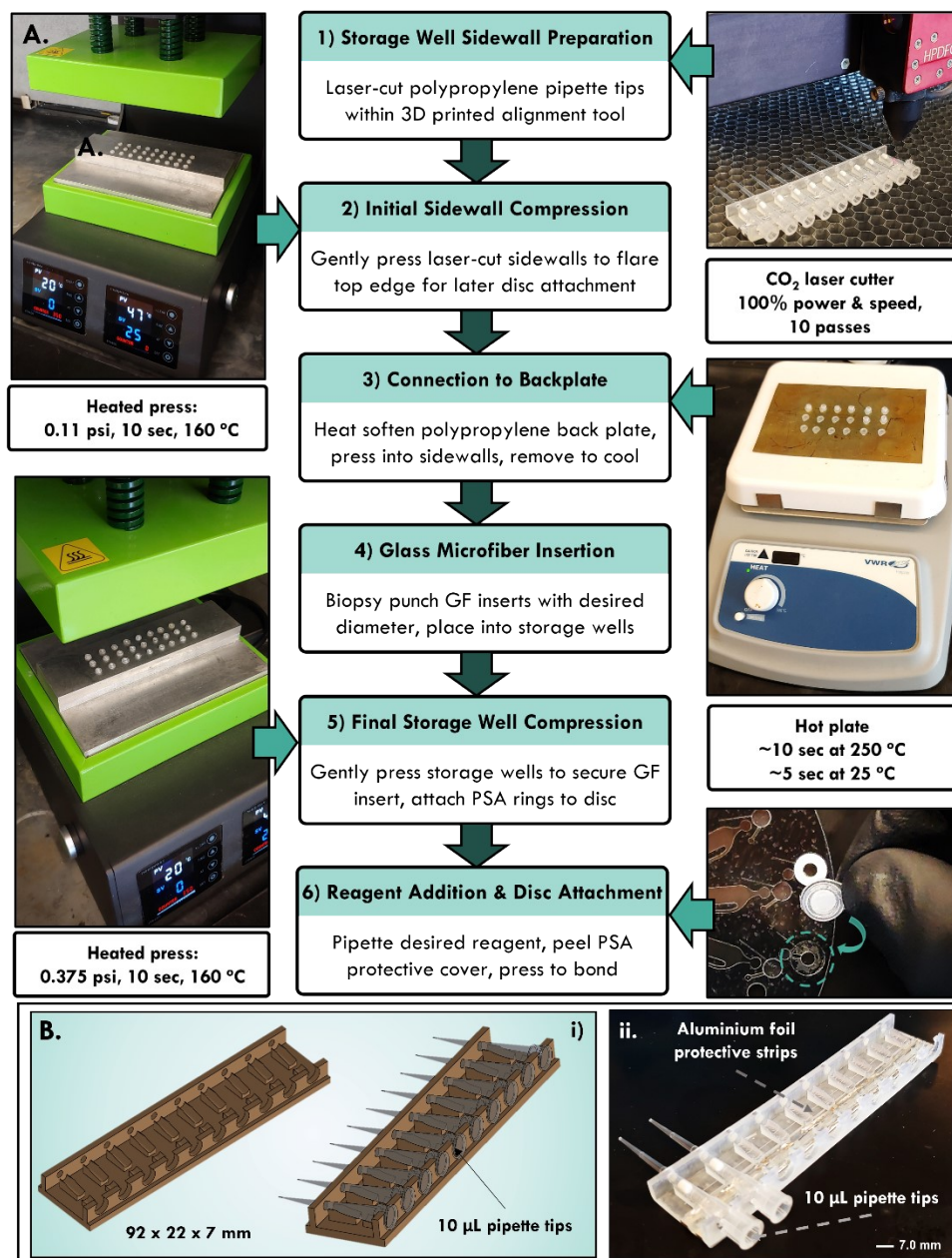
Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 1. Design and assembly of PCL Microdevices. **A.** Exploded view SolidWorks rendering of the PCL centrifugal microfluidic device used for heavy metal detection. Main device layers 1 and 5 act as optically transparent vent and sealing layers, respectively. Middle layer 3, composed of bPET, acts as an optically-dense valving layer. Layers 2 and 4 contain the laser-cut fluidic architecture, with the HSA providing a high-strength bond to seal all device layers during final lamination. Accessory components a-d) are either included prior to lamination (i.e., FEP) or attached added post lamination (i.e., PSA and wells). Inset at bottom left shows actual example image of a 2.5 mm storage well. **B.** Solid works rendering of laminated microdevice with attached wells. **C.** SolidWorks cross section of an attached 2.5 mm storage well alongside a 4.0 mm well.

Supplementary Information

Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 2. Fabrication and assembly of corrosive reagent microencapsulation wells. **A.** Workflow for fabrication of custom 2.5 and 4.0 mm internal diameter storage chambers using commercially available materials (i.e., polypropylene pipette tips and PCR tubes) and equipment (e.g., laser cutter, heated press, hot plate, and 3D printer). Of note, the assembly process for 4.0 mm storage wells only requires steps 4-6. **B.** SolidWorks rendering of i) 3D printed alignment tray for laser-cutting of sidewalls (Step 1) alongside ii) an actual image. Aluminum foil strips are required to prevent undesirable laser-cutting of the tray. Assembly of corrosive reagent storage-capable microdevices requires three basic steps: 1) alignment of laser-cut disc layers, with interposition of the FEP film between layers 1 and 2, followed by lamination and attachment of the PSA ring to the underside of layer 5, 2) followed by deposition of the corrosive reagent(s) of choice into the previously prepared storage chambers, and finally 3) bonding of the storage chamber(s) to the microdevice using the exposed PSA ring.

Supplementary Information

Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221

A. Conc. HNO ₃					B. Conc. H ₂ SO ₄				
Materials	0 min	30 min	24 hrs	2 weeks	Materials	0 min	30 min	24 hrs	2 weeks
FEP	Compatible	Compatible	Compatible	Compatible	FEP	Compatible	Compatible	Compatible	Compatible
PMMA	Compatible	Compatible	Likely Incompatible	Likely Incompatible	PMMA	Compatible	Compatible	Incompatible	Incompatible
Parafilm	Compatible	Compatible	Compatible	Compatible	Parafilm	Compatible	Compatible	Compatible	Compatible
COC	Compatible	Compatible	Compatible	Compatible	COC	Compatible	Compatible	Compatible	Compatible
PET	Compatible	Compatible	Compatible	Compatible	PET	Likely Incompatible	Incompatible	Incompatible	Incompatible
bPET	Compatible	Compatible	Compatible	Compatible	bPET	Likely Incompatible	Incompatible	Incompatible	Incompatible
tPET	Compatible	Compatible	Likely Incompatible	Likely Incompatible	tPET	Likely Incompatible	Incompatible	Incompatible	Incompatible
HAA	Likely Incompatible	Likely Incompatible	Incompatible	Incompatible	HAA	Likely Incompatible	Incompatible	Incompatible	Incompatible
dsPSA	Likely Incompatible	Incompatible	Incompatible	Incompatible	dsPSA	Likely Incompatible	Incompatible	Incompatible	Incompatible
ssPSA	Likely Incompatible	Likely Incompatible	Likely Incompatible	Likely Incompatible	ssPSA	Likely Incompatible	Incompatible	Incompatible	Incompatible
Epoxy 21	Incompatible	Incompatible	Incompatible	Incompatible	Epoxy 21	Incompatible	Incompatible	Incompatible	Incompatible
Epoxy 62	Incompatible	Incompatible	Incompatible	Incompatible	Epoxy 62	Incompatible	Incompatible	Incompatible	Incompatible
*Clear Resin	Likely Incompatible	Likely Incompatible	Likely Incompatible	Likely Incompatible	*Clear Resin	Likely Incompatible	Likely Incompatible	Likely Incompatible	Likely Incompatible
*Durable Resin	Likely Incompatible	Likely Incompatible	Likely Incompatible	Likely Incompatible	*Durable Resin	Likely Incompatible	Likely Incompatible	Likely Incompatible	Likely Incompatible

C. H ₂ O		Conc. HNO ₃		Conc. H ₂ SO ₄	
0 min	24 hrs	0 min	24 hrs	0 min	24 hrs

Compatible: No visible or physical change in material

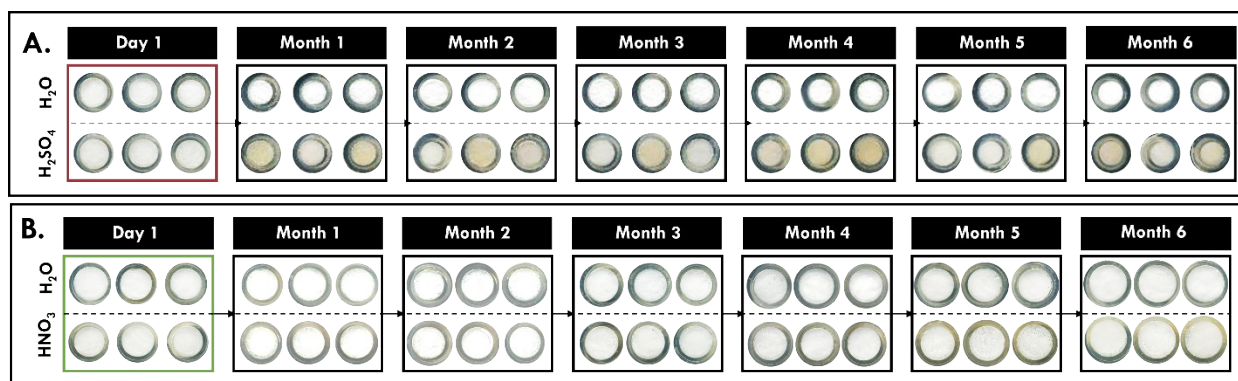
Likely Incompatible: Color change or leaching observed

Incompatible: Material fully corroded

Supplementary Figure 3. Microdevice material compatibility tests. Various materials, including: fluorinated ethylene propylene (FEP), poly(methylmethacrylate) (PMMA), Parafilm, cyclic olefin copolymer (COC), polyethylene terephthalate (PET), black PET (bPET), PET with black toner printed 2x on either side (tPET), heat activated adhesive (HAA), double-sided pressure sensitive adhesive (dsPSA), single-side pressure sensitive adhesive (ssPSA), Master Bond epoxies (Epoxy 21 and Epoxy 62), and FormLabs Clear and Durable Resin were laser-cut then submerged in MQ H₂O, **A.** [15.8 M] HNO₃, or **B.** [18 M] H₂SO₄, and evaluated immediately after exposure (0 min), then again after: 30 min, 24 hrs, and 2 weeks. **C.** Example images of exposed material. From left to right: PSA after exposure to: MQ H₂O, conc. HNO₃, or conc. H₂SO₄ immediately after submersion then again after 24 hrs. *Indicates material was 3D printed rather than laser-cut with a CO₂ laser.

Supplementary Information

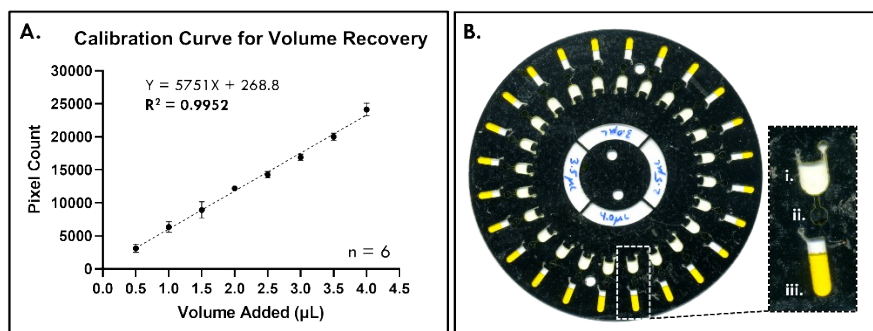
Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 4. Six Month Storage Evaluation of Microencapsulated H_2SO_4 and HNO_3 On-Disc. **A.** Example scanned images (magnified) of microencapsulation chambers containing either 5 μ L of MQ H_2O or [18 M] H_2SO_4 after 1-6 months of storage at room temperature. **B.** Example scanned images (magnified) of microencapsulation chambers containing either 5 μ L of MQ H_2O or [15.8 M] HNO_3 after 1-6 months of storage at -20 °C in light protective containers.

Supplementary Information

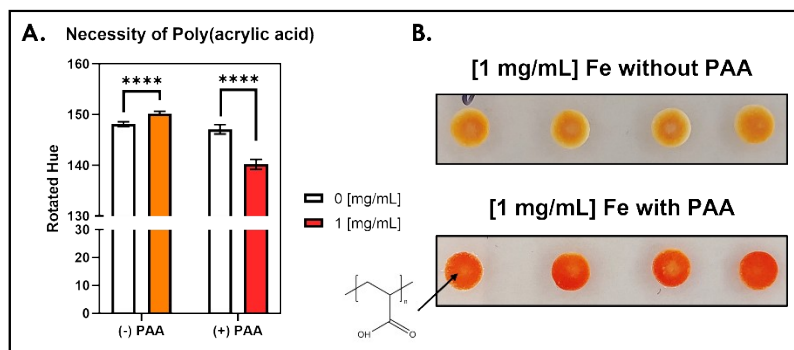
Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 5. *Image Analysis Calibration Curve and Correction Factor for GF Insert Volume Recovery.* **A.** Plot of the volume of yellow dye added versus pixel count measured in the recovery chamber (n=6, error bars represent the sample standard deviation around the mean). Analysis was performed in Fiji in the Y'UV colorspace (color threshold settings: Y' = 50–255, U = 0–100 and V= 130–255). Regression line was fit in Prism. **B.** Example of scanned image used for analysis. Disc was composed of i) a fluidic inlet chamber, ii) an optofluidic valve, and iii) a recovery chamber. The fluidic inlet chambers were located in the precise location of the eventual attached storage wells to mimic the appropriate RCF. The valve and recovery chamber were identical to the eventual disc with attached storage wells. This design was intended to account for the expected loss of volume within the valve relative to a known input volume.

Supplementary Information

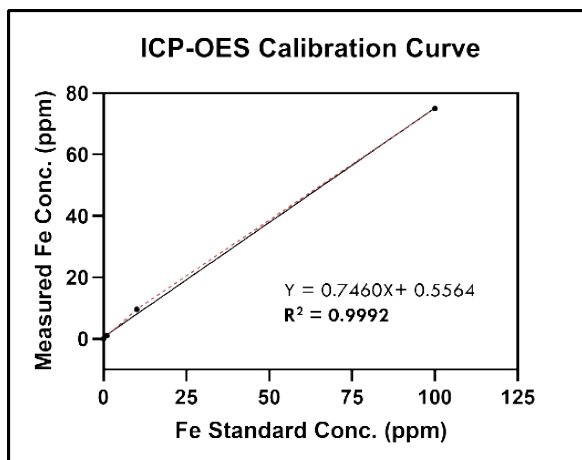
Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 6. Necessity of PAA. **A.** Result of image analysis evaluating the difference in average hue values observed for positive ([1 mg/mL] $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$) and negative (MQ H_2O) samples, detected with “(+)” or without “(-)” PAA ($n=4$, error bars represent the sample standard deviation around the mean). A Student’s t-test performed in Prism revealed one order of magnitude difference in the P-values associated with the change between negative and positives samples (P-values: 0.0004 and 0.00005 for (-) PAA and (+) PAA respectively, α -level: 0.05). **B.** Image of actual results performed on 4.0 mm GF/F inserts. Iron detection reagents were deposited onto the GF and allowed to dry, protected from light, prior to addition of samples.

Supplementary Information

Dielectric Heating of Highly Corrosive and Oxidizing Reagents on a Hybrid Glass Microfiber-Polymer Centrifugal Microfluidic Device, LC-ART-03-2022-000221



Supplementary Figure 7. Calibration Curve for ICP-OES Analysis.