Electronic Supplementary Material (ESI) for Analytical Methods.

Supporting Information

Integrated wax valve for robust fluid control in an electrochemical fabric-based device

Corey Downs, Arianna Nejely, and Elain Fu*

School of Chemical, Biological, and Environmental Engineering, Oregon State University, Corvallis, OR 97331

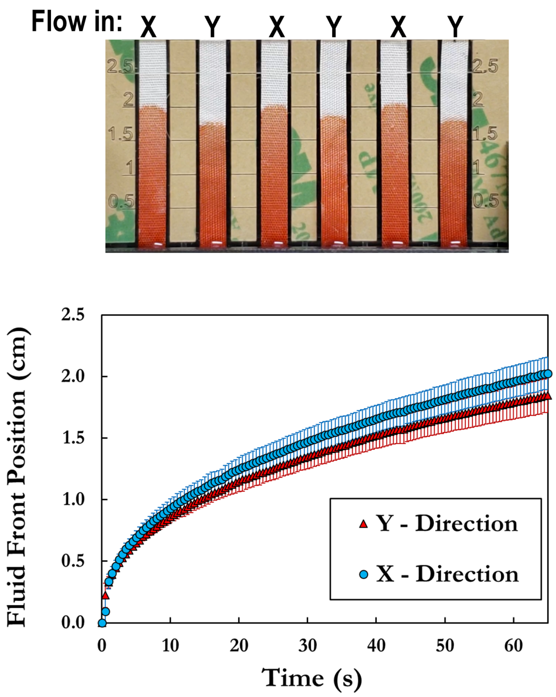

Figure S1. (A) Images of fabric strips in which red-dyed fluid flowed horizontally along the x- (warp) or y-direction (weft) in the fabric. Fluid progression was faster along x than y. (B) The plot shows the average position of the fluid front vs. time for horizontal flow along each fabric orientation. Error bars represent the standard deviation. The power law exponent was estimated for each case (using regression analysis tools in Microsoft Excel) to be ~0.42 and 0.41 for the x- and y-directions, respectively. Data within the first 0.5 seconds, inclusive, was omitted from fitting in order to avoid start-up artifacts.

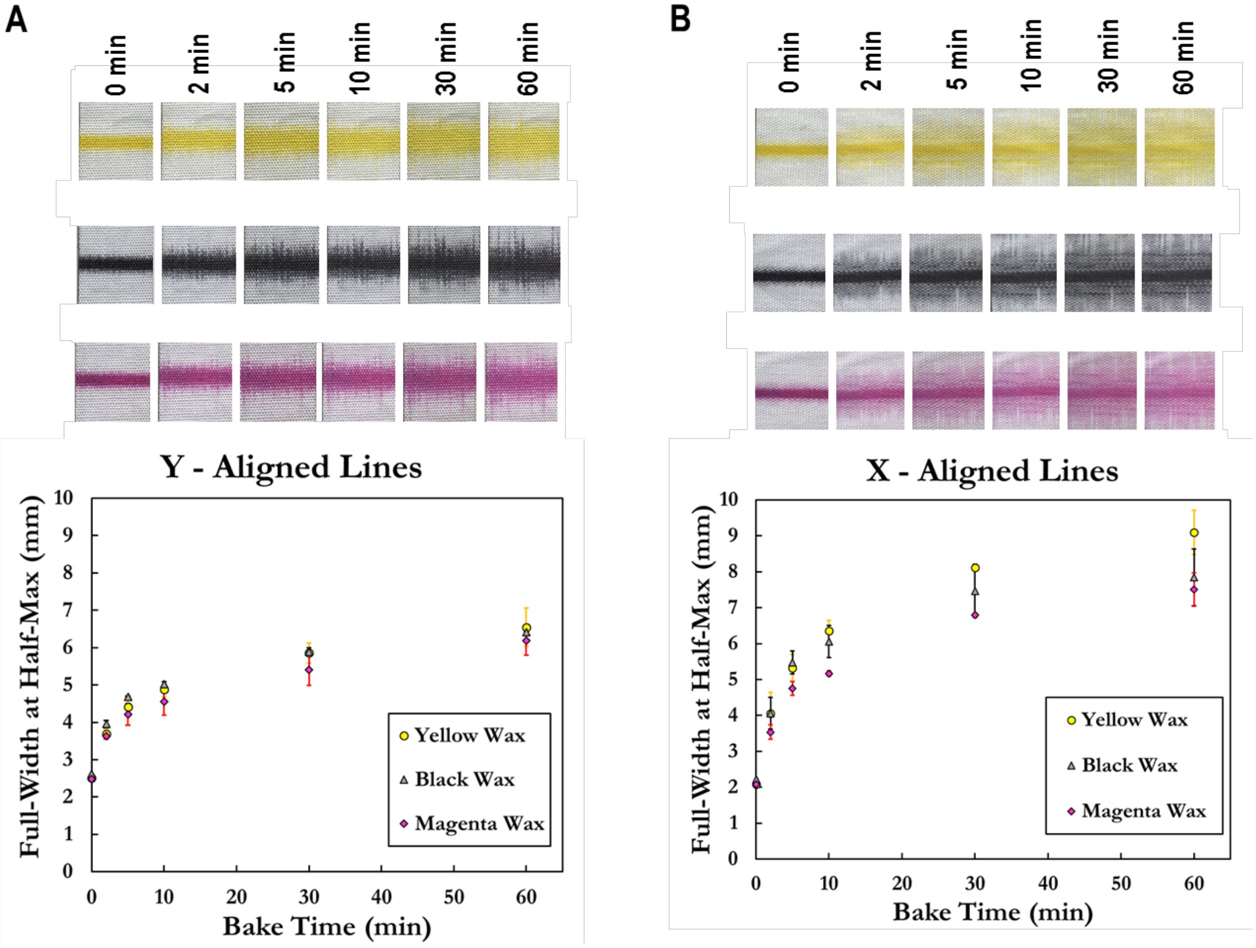

Figure S2. Characterization of wax line spread (T = 100 °C) along (A) y- and (B) x-directions in the fabric, as a function of heating time, 0 – 60 minutes for yellow, black, and magenta wax. Representative images of wax lines are shown at each heating time for visual comparison (top). Line widths were quantified by isolating the color profile (similar to those shown in **Figure 2**) and determining the width of the profile at half the maximum value (bottom) (*N* = 3). These results indicate differences in wax-spreading behavior for the two material orientations (y- vs. x-direction) and the color of wax used. Magenta wax aligned in the y-direction yielded the smallest line width and was used for fabrication of the closed valve.

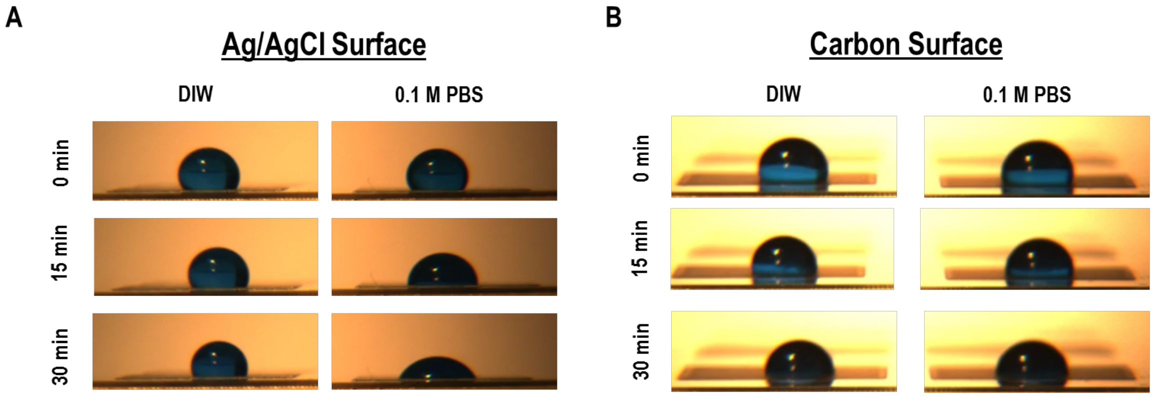

Figure S3. Characterization of differential wetting of (A) Ag/AgCl and (B) carbon (with Prussian blue) stencil-printed surfaces (used for heater and reference electrode fabrication, and working and counter electrode fabrication, respectively) by deionized water (DIW) (left) and 0.1 M phosphate buffered saline solution at pH 6 (right). A 20 µL droplet of each fluid was applied to each surface and recorded via microscope and camera over a period of 30 minutes. The ionic PBS solution began to imbibe into the porous Ag/AgCl structure upon application, while DIW remained on the surface of the material. In contrast, no differences in wetting based on the solution were observed for the carbon surface (droplet size changes on the carbon surface were attributed to evaporation effects).