# Optimizing HKUST-1 Electrospun Fibers for Dye Filtration

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How to best optimize electrospun fibers of HKUST-1 and polystyrene for methylene blue dye filtration?

**Background:** Metal-organic frameworks are highly porous and ordered crystalline compounds with high surface area to volume ratios. This makes them suitable for adsorption processes in applications in gas storage, separation, etc. This also includes filtration of charged organic dyes that adsorb to MOF membranes while allowing the rest of an aqueous solution pass. One way to create a suitable MOF membrane is by electrospinning a MOF with a polymer. Electrospinning is a fiber production method which uses electric force to draw charged threads of polymer solutions. The addition of PEO to this mixture can also be washed with water post-synthesis to make fibers more porous. A drawback to this is damage to HKUST-1 from water exposure.

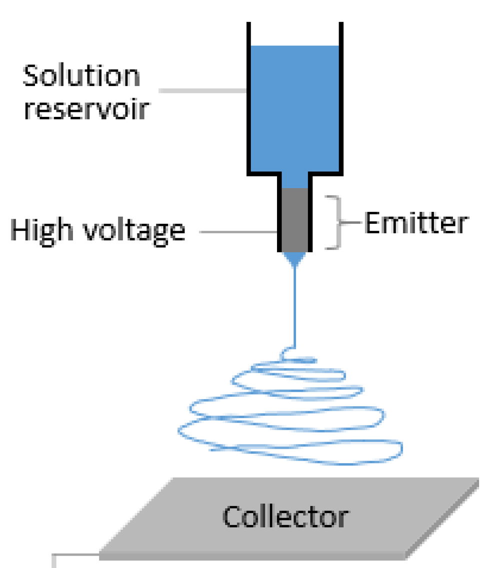
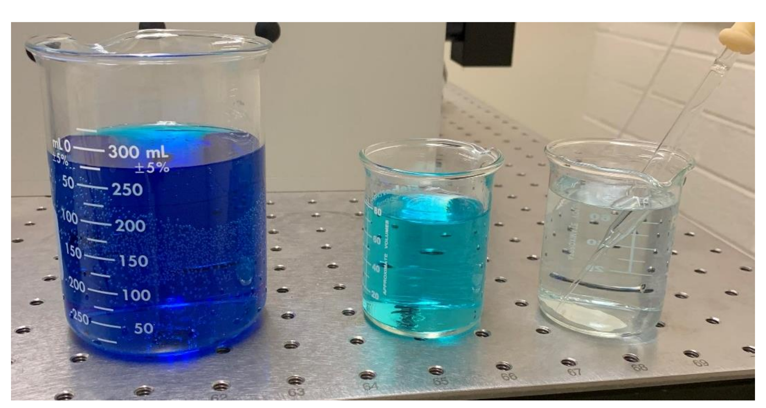



Fig. 1 Basic Electrospinning Set Up

**Latest Results:**

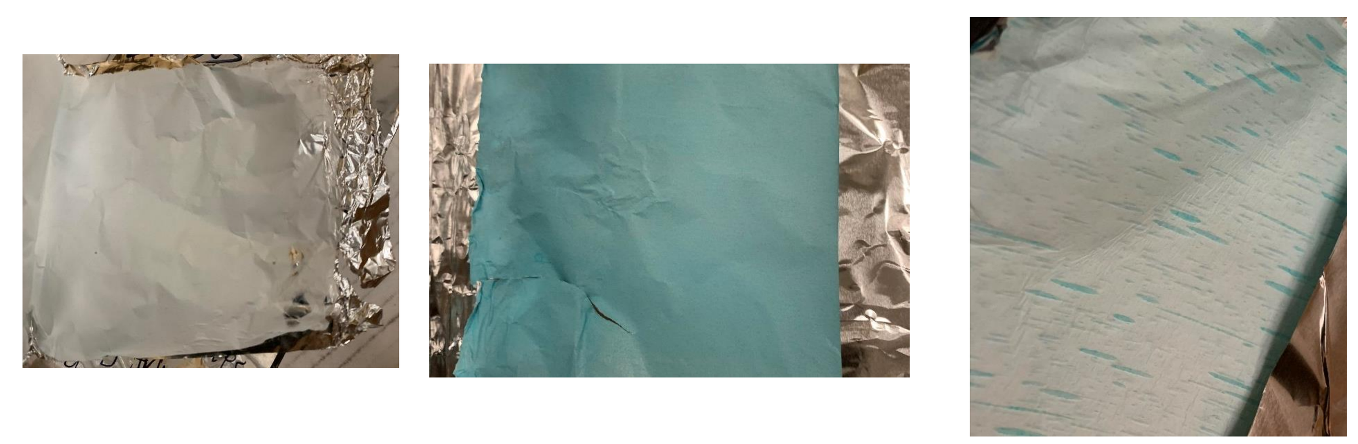


Left to Right: Dye soln.'s after filtration 5x. 1st is original soln. 2nd is after Sample **1**, 3rd after Sample **3**

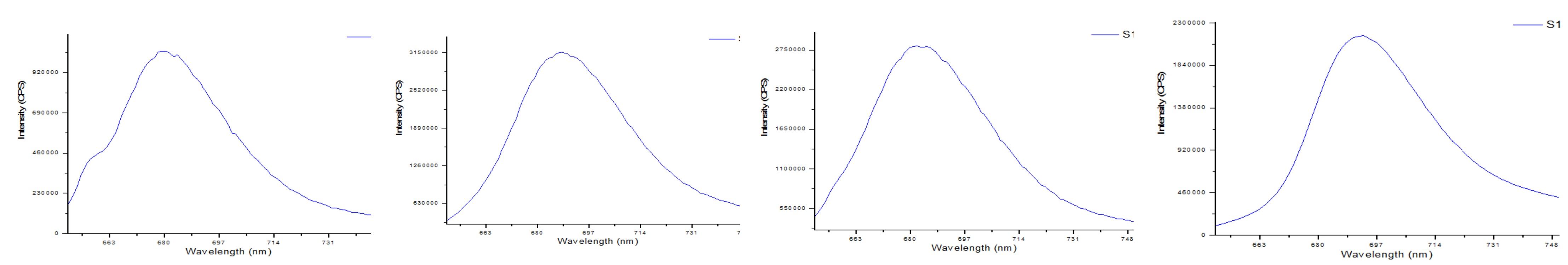
**Methods:** HKUST-1 was first synthesized using hydrothermal synthesis in an autoclave with a solution of BTC and Cu$(NO_3)_2$ before the finished product was put in a particle solution which mixed with a polysyrene/PEO solutions. Fibers recipes **1, 2, and 3 successfully produced viable fibers samples.** Fig 3 shows spectrometer used to characterize.

| Sample Number | Description | Recipe |
|---|---|---|
| 1 | Thin, Washed | 400 mg PEO + 400 mg PS + 400 mg HKUST-1<br>4 mL Acetone + 6 mL DMF |
| 2 | Thin, Unwashed | 400 mg PEO + 400 mg PS + 400 mg HKUST-1<br>4 mL Acetone + 6 mL DMF |
| 3 | Thick, unwashed | 1200 mg PEO + 1200 mg PS + 1200 mg HKUST-1<br>12 mL Acetone + 18 mL DMF |

Samples **1,2,3** side by side. Note discoloration from water damage in sample 1:



Spectrometer Data



Fluorescence plots for 665 nm excitation: Peak of 950,000 , 315,000 , 275,000 , and 220, 000 for base and samples **1,2,3** respectively

Fig. 2 Filtration Flask Set-Up

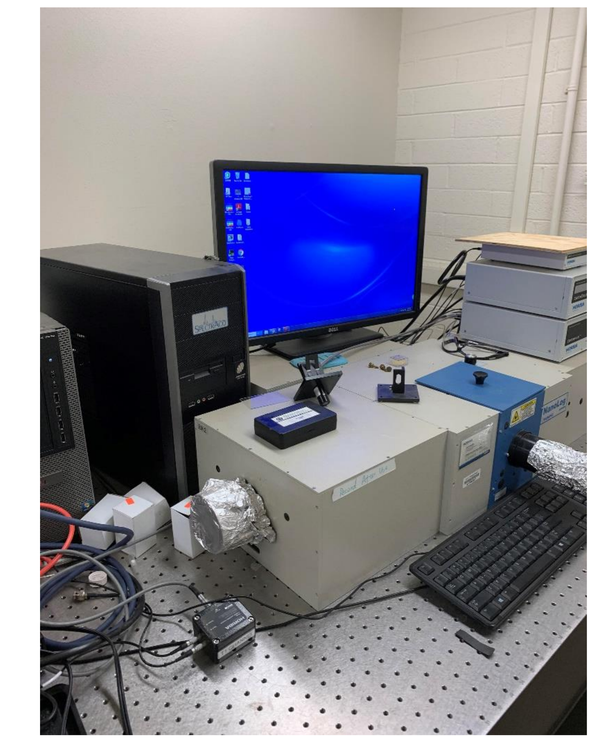


Fig. 3 Fluorescence Spectrometer

**Conclusion & Future Work:** This work shows that the electrospinning method used is effective and reproducible for dye filtration. Data also shows that extra porosity by removal of PEO in fibers is offset by water damage to HKUST-1 during washing. Thicker membranes with more HKUST-1 content proved the superior fibers for dye filtration. Work in the future should investigate filtration potential of more MOF and polymer combinations.

**References:**

Qiu, S.; Xue, M.; Zhu, G. Chem. Soc. Rev. 2014, 43 (16), 6116–6140

Chen, Y., Liu, H., Hu, X., Cheng, B., Liu, D., Zhang, Y., & Nair, S. (2017). PVDF/Cu-BTC composite membranes for dye separation. Fibers and Polymers, 18(7), 1250–1254.