

Functional
Framework
Materials
by organic synthesis



Literature Talk

Prof. William Dichtel - Northwestern University

17.04.2020

Sebastian M. Pallasch

Prof. William Dichtel

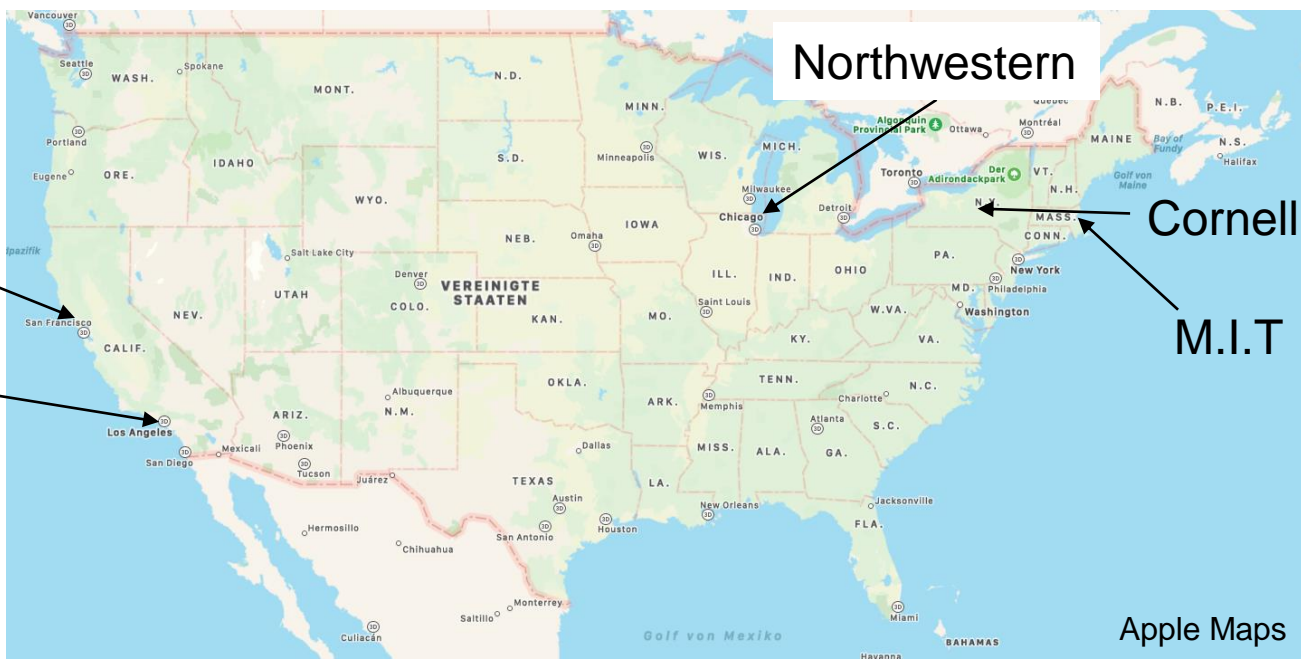
Curriculum Vitae

S.Pallasch

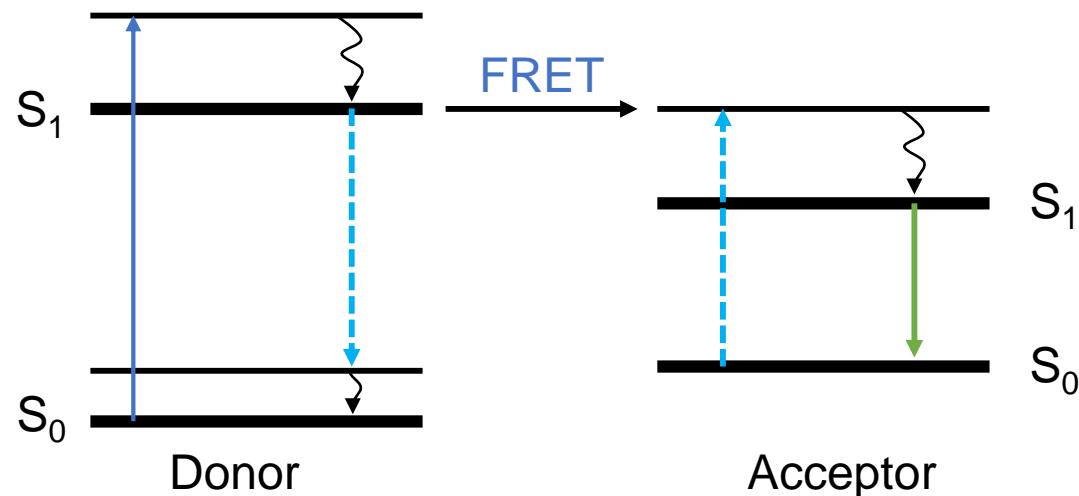
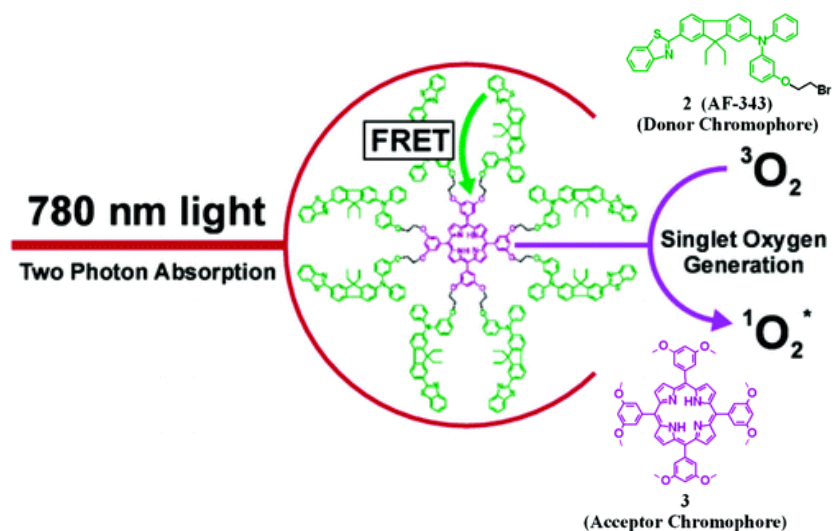
- 2000 B.Sc. in Chemistry, Massachusetts Institute of Technology
- 2005 Ph.D in Chemistry, University of California – Berkeley (Advisor: Jean M. J. Fréchet)
- 2005–2008 Joint Research Associate, University of California (UCLA) and Caltech (with Fraser Stoddart)
- 2008–2014 Assistant Professor, Cornell University
- 2014–2016 Associate Professor, Cornell University
- 2016–present Professor, Northwestern University



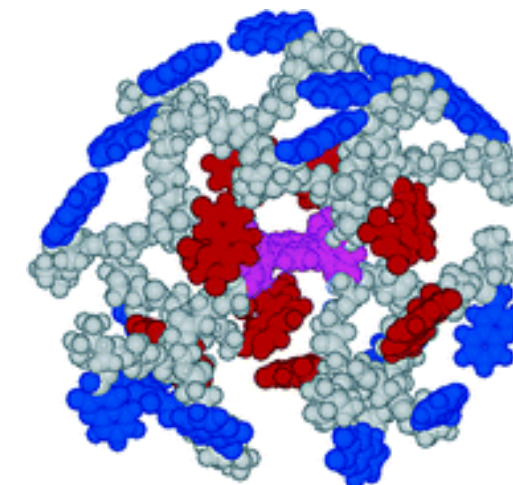
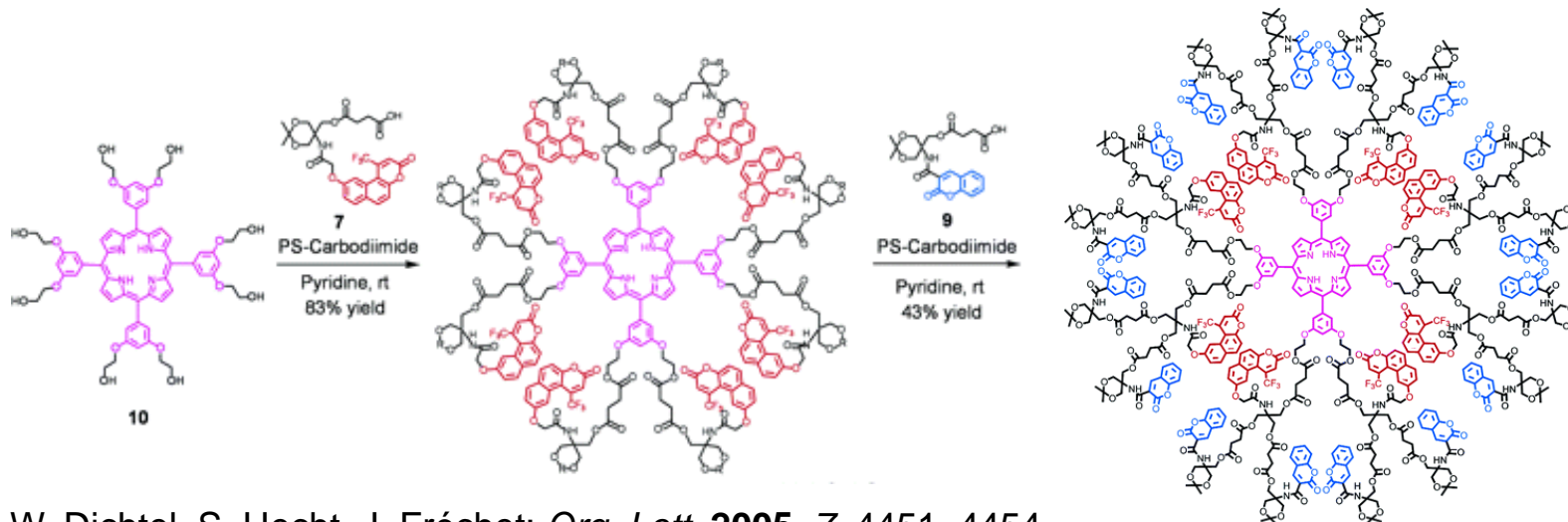
Dichtel Research Group



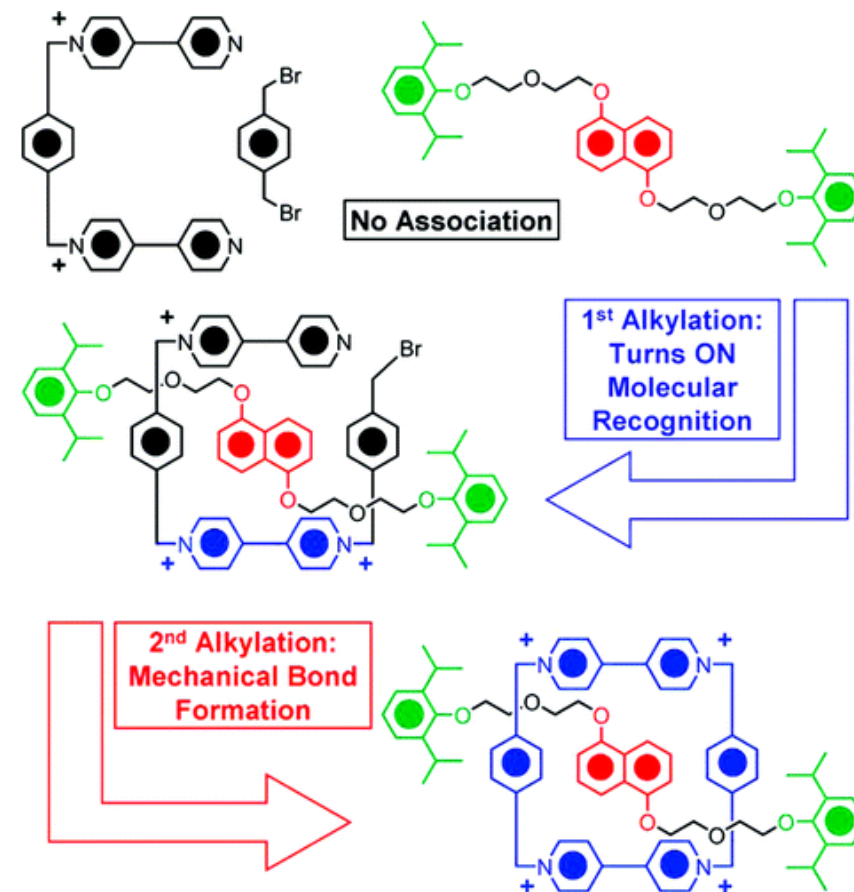
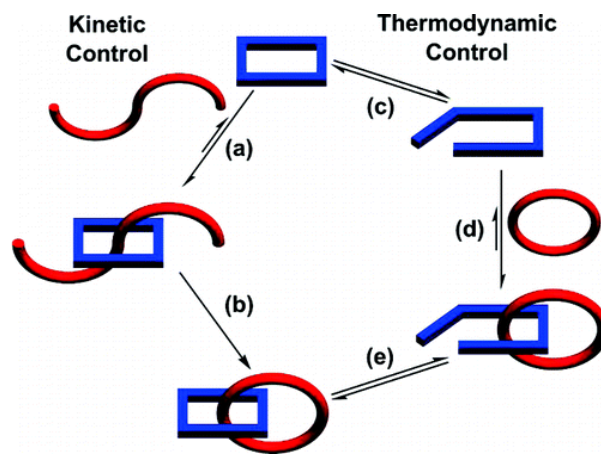
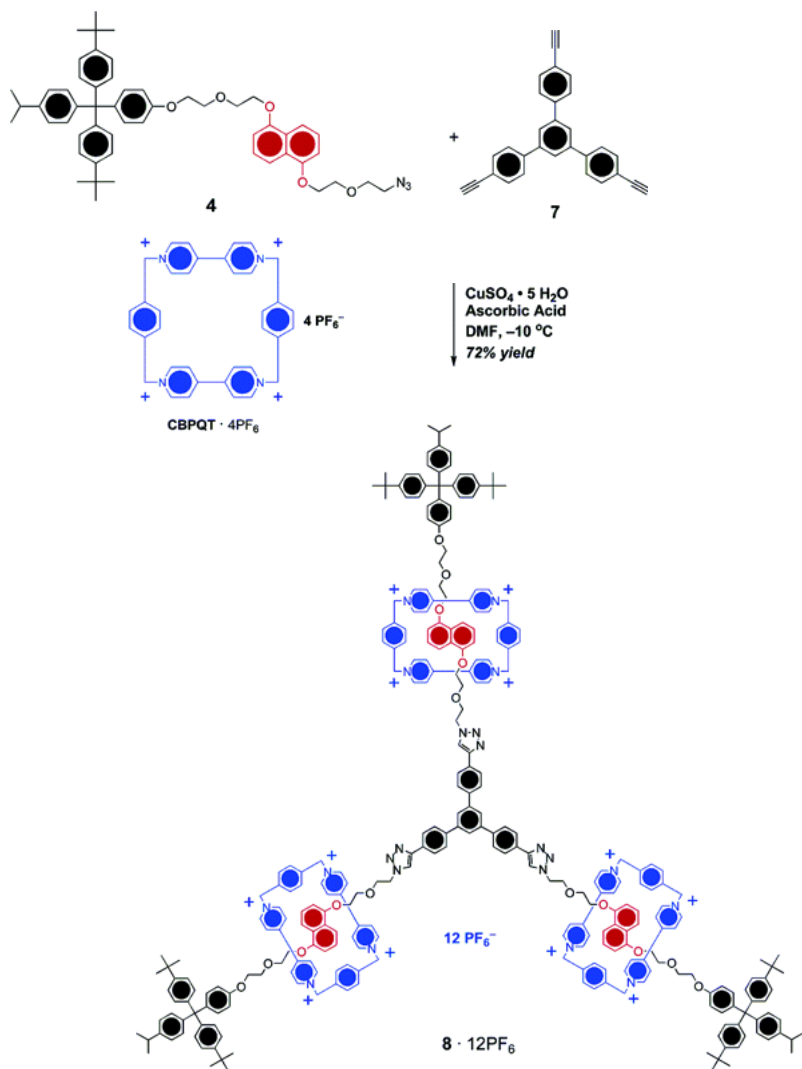
- 129 Publications, 11033 Citations
- *h*-Index: 57 (04/2020)
- > 20 Awards and Honors (MacArthur Fellowship, Cope Scholar Award, ...)



W. Dichtel, J. Serin, J. Fréchet, P. Prasad; *J. Am. Chem. Soc.* **2004**, *126*, 5380–5381



W. Dichtel, S. Hecht, J. Fréchet; *Org. Lett.* **2005**, *7*, 4451–4454



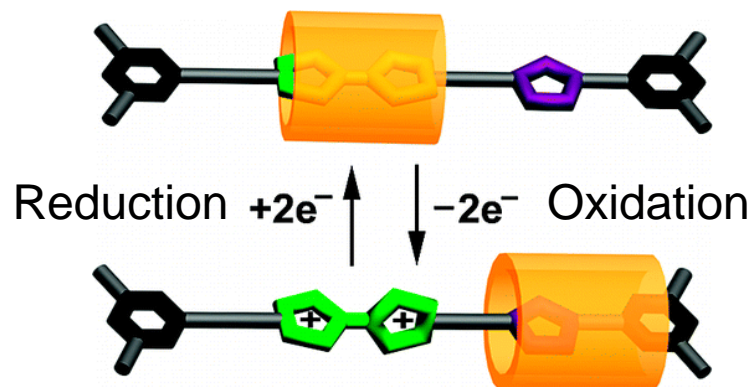
W. Dichtel, O. Miljanić, J. Spruell, F. Stoddart *J. Am. Chem. Soc.* **2006**, *128*, 10388–10390

W. Dichtel, O. Miljanić, W. Zhang, F. Stoddart *Acc. Chem. Res.* **2008**, *41*, 1750–1761

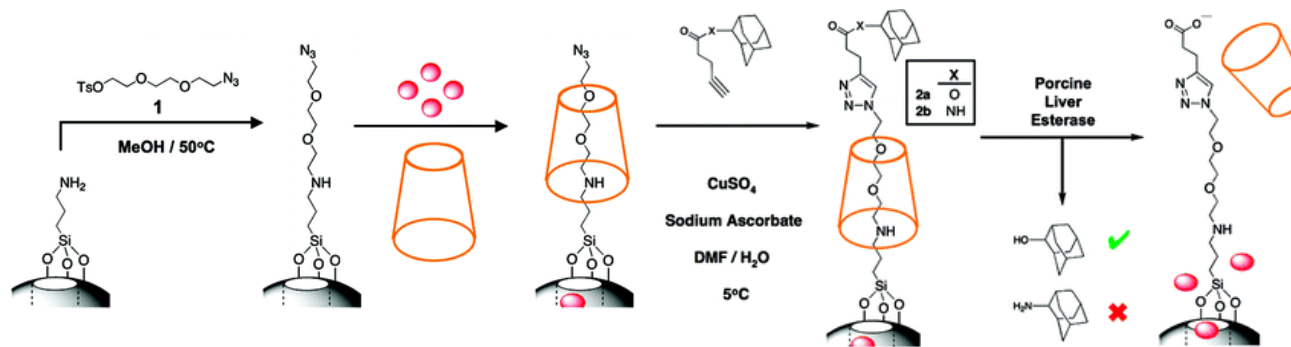
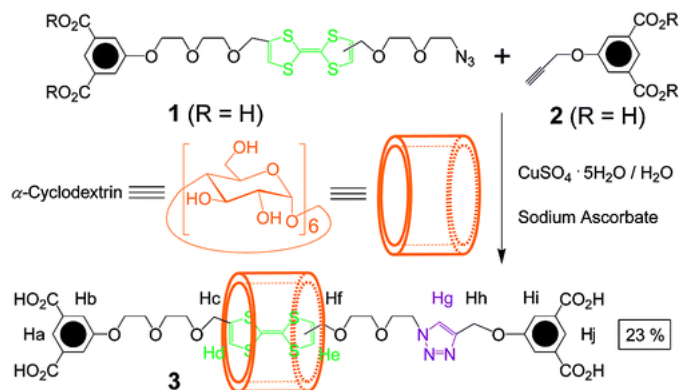
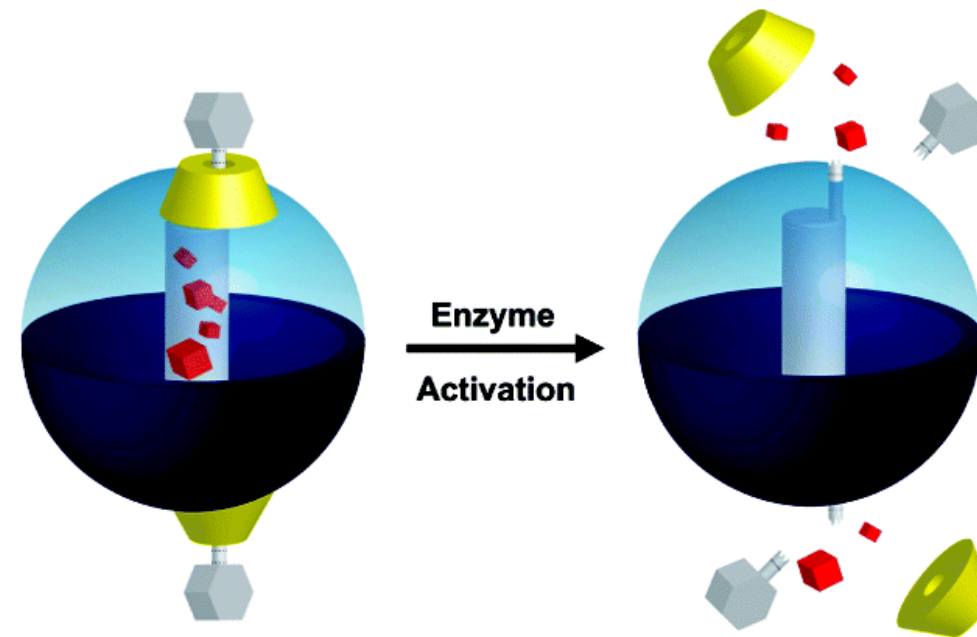
Prof. William Dichtel

Molecular Machines

S.Pallasch

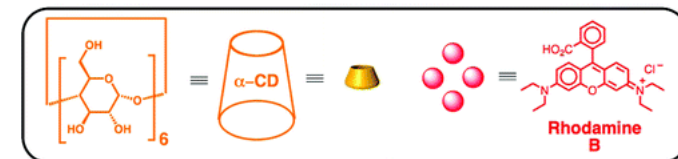


with Sir J. Fraser Stoddart

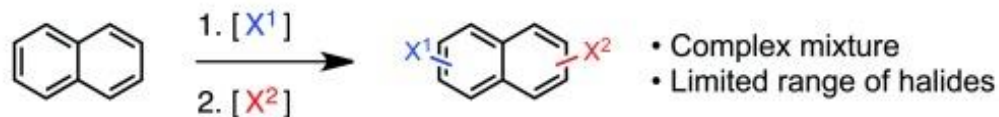


Y. Zhao, W. Dichtel, A. Trabolsi, F. Stoddart; *J. Am. Chem. Soc.* **2008**, *130*, 11294–11296

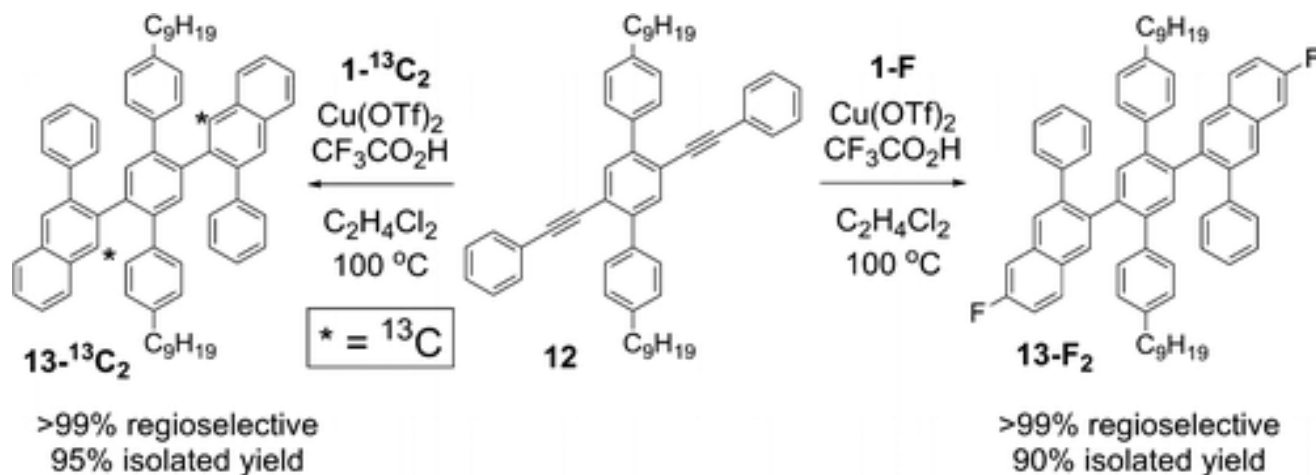
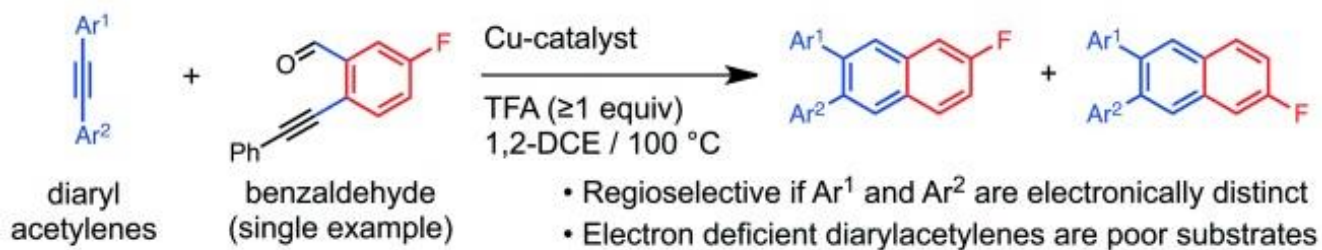
K. Patel, S. Angelos, W. Dichtel, F. Stoddart; *J. Am. Chem. Soc.* **2008**, *130*, 2382–2383



Direct Halogenation



Benzannulation of Diarylacetylenes

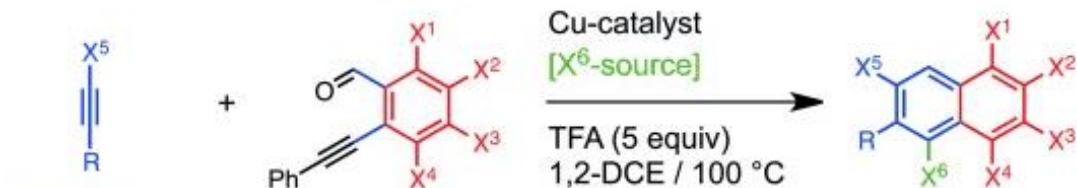


substrate	product(s)	ratio (isolated yield)
		>99:1 (78%)
		>99:1 (63%)
		49:51 (95%)
		49:51 (82%)
		>99:1 (99%)
		>99:1 (97%)
		55:45 (60%)

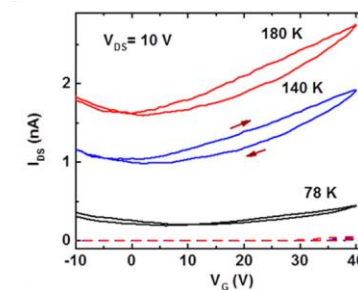
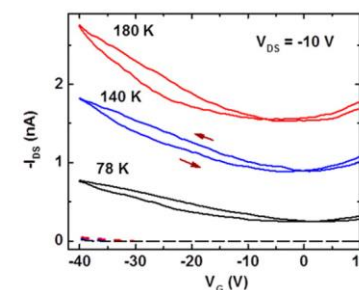
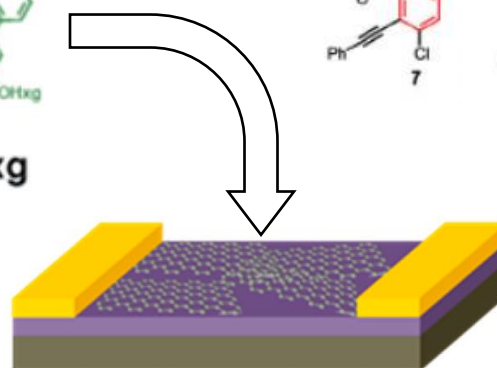
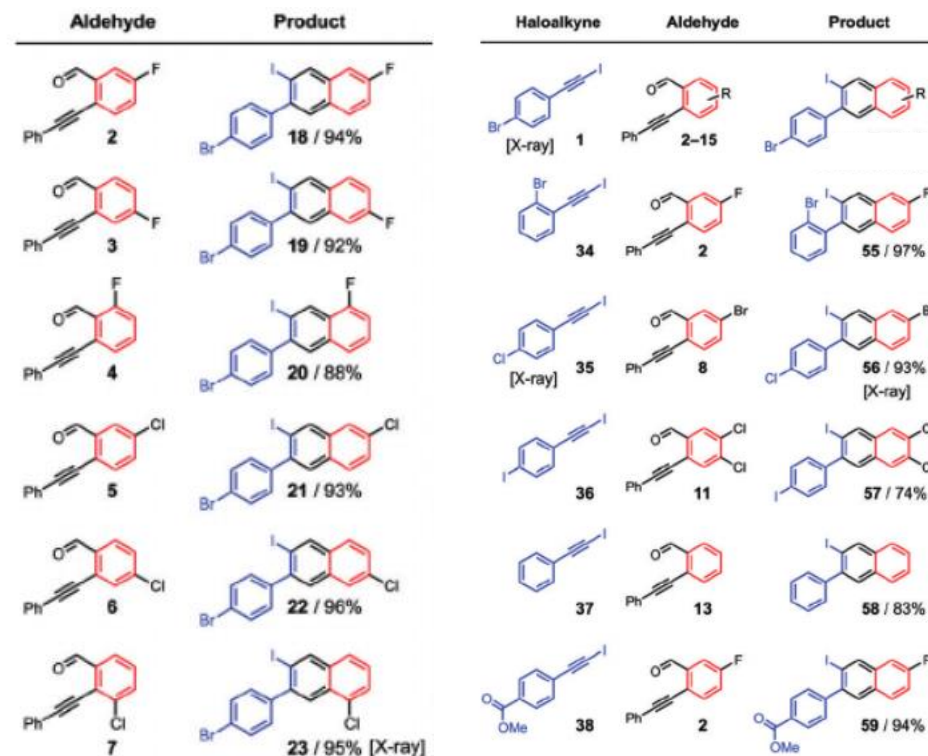
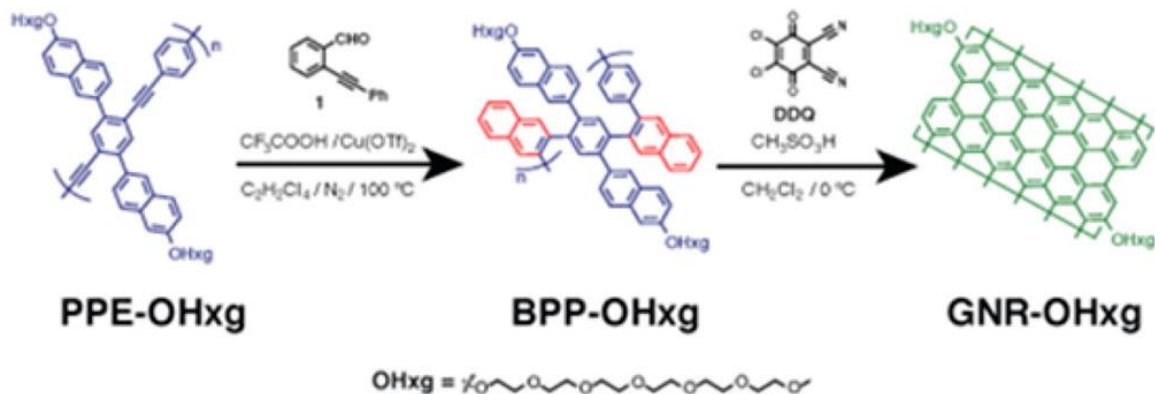
H. Arslan, K. Walker, W. Dichtel; *Org. Lett.* **2014**, *16*, 5926–5929

D. Lehnerr, J. Alzola, W. Dichtel; *Chem. Eur. J.* **2015**, *21*, 18122–18127

Benzannulation of Haloalkynes

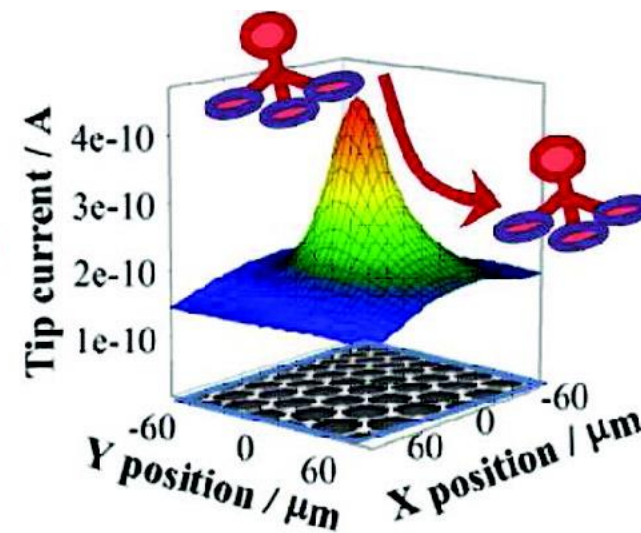
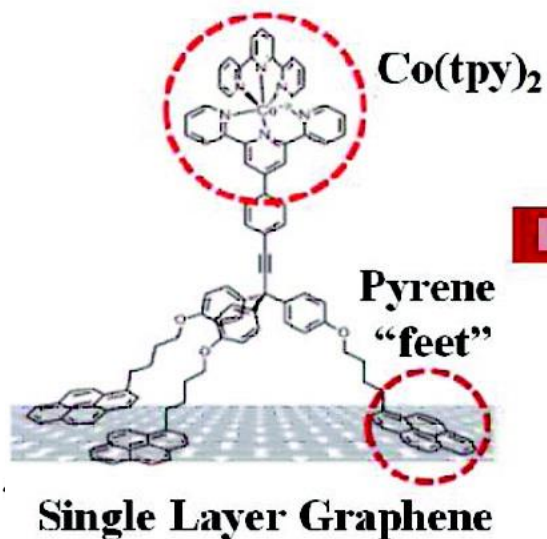
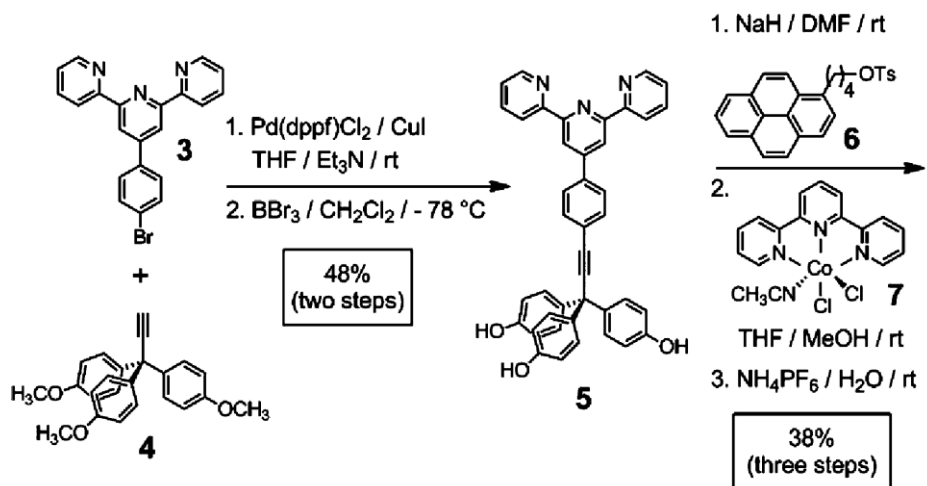
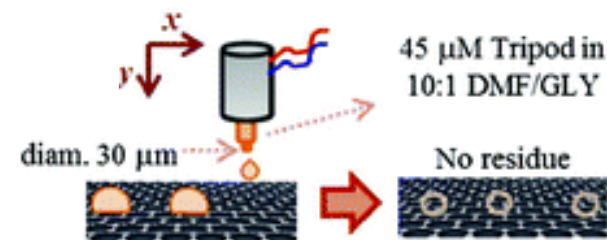
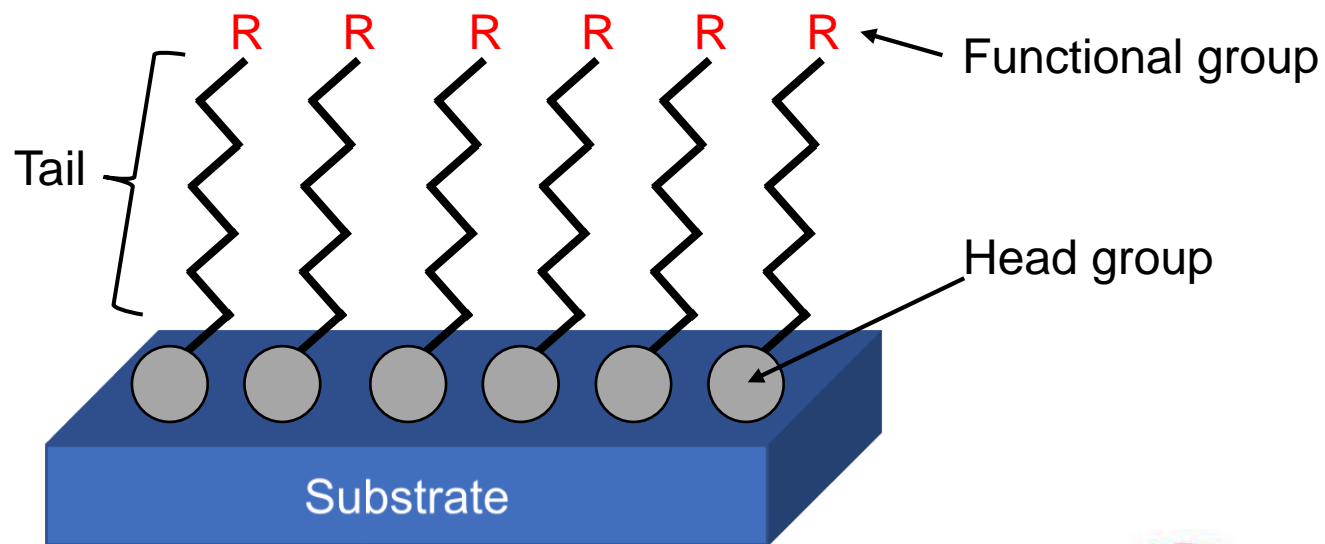


- Substrates are typically 1 step from commercial compounds
- Single regioisomer products
- Independent control over X^1 - X^6 & R
- Electron deficient arylacetylenes are excellent substrates
- 44 halogenated naphthalene examples



J. Gao, F. Uribe-Romo, W. Dichtel, Y. Loo; *ACS Nano* **2016**, *10*, 4847–4856

D. Lehnerr, J. Alzola, W. Dichtel; *Chem. Eur. J.* **2015**, *21*, 18122–18127

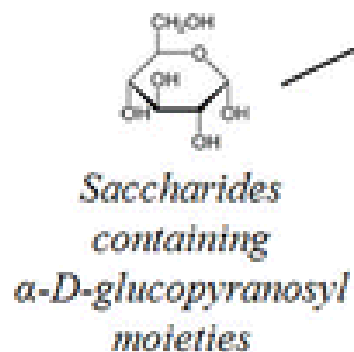


J. Mann, J. Rodríguez-López, H. Abruña, W. Dichtel; *J. Am. Chem. Soc.* **2011**, *133*, 17614–17617

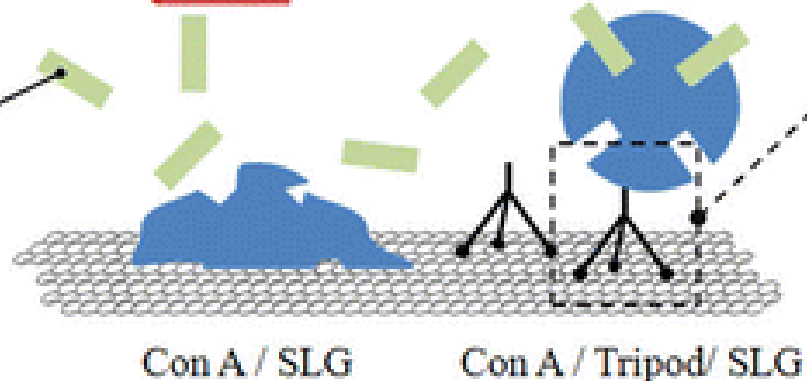
J. Rodríguez-López, N. Ritzert, J. Mann, C. Tan, W. Dichtel, H. Abruña; *J. Am. Chem. Soc.* **2012**, *134*, 6224–6236



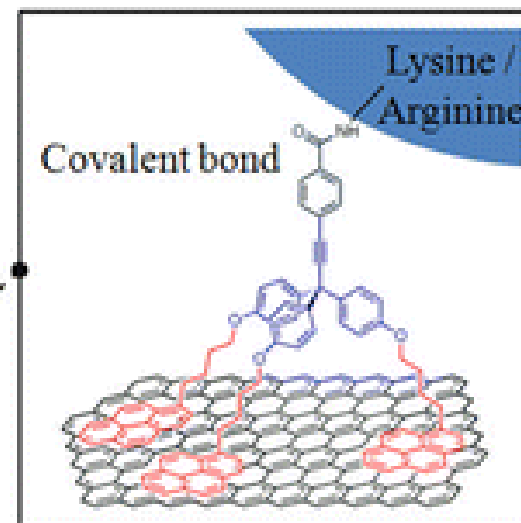
Concanavalin A



Loss of biological function

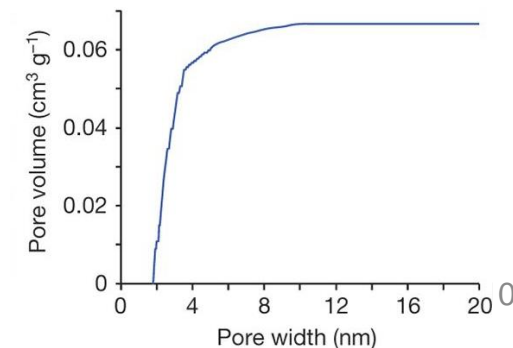
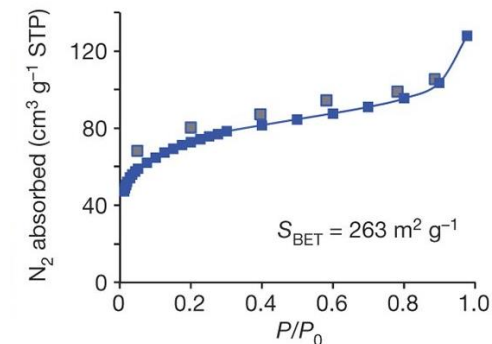
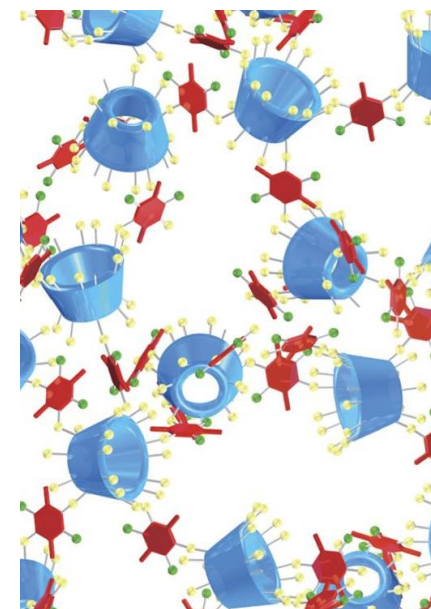
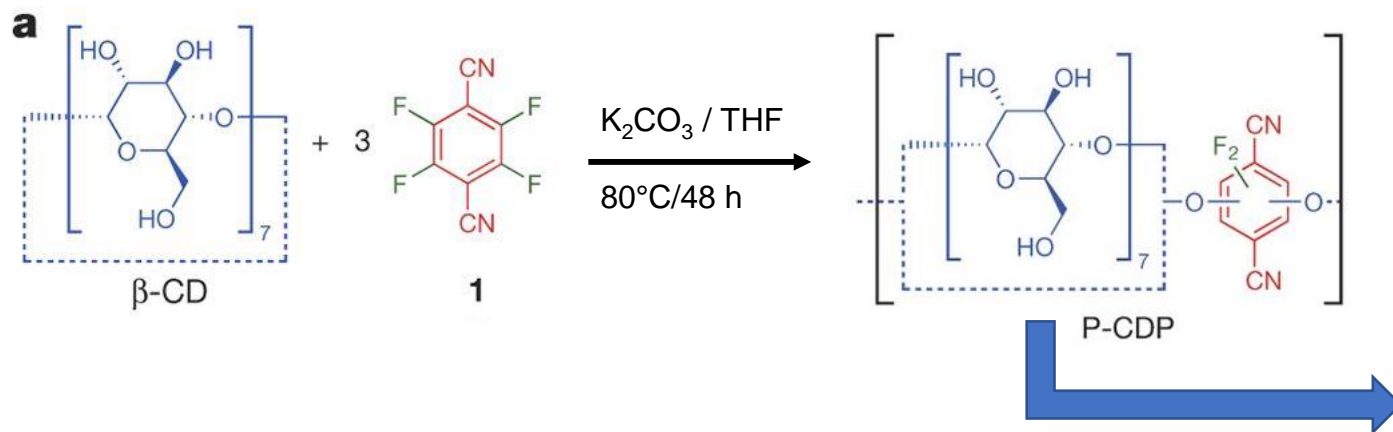
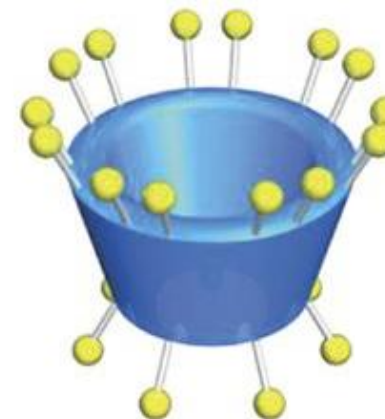
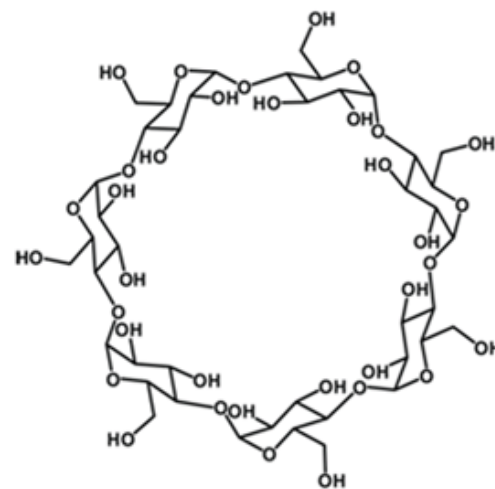
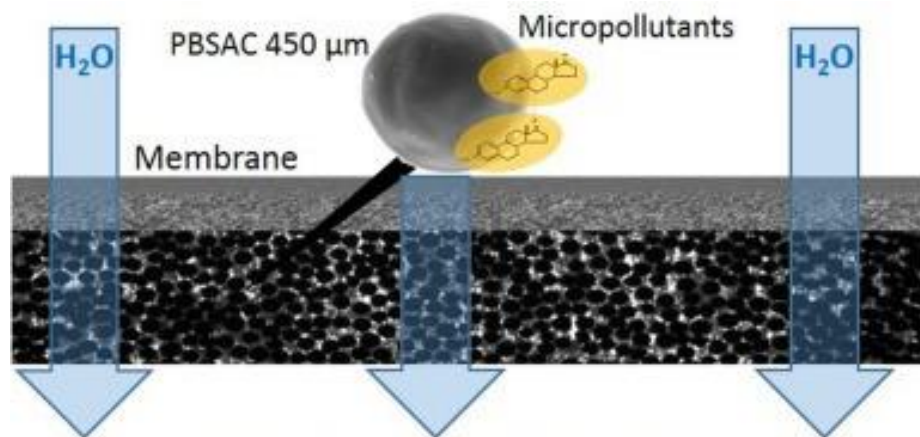


Specific binding



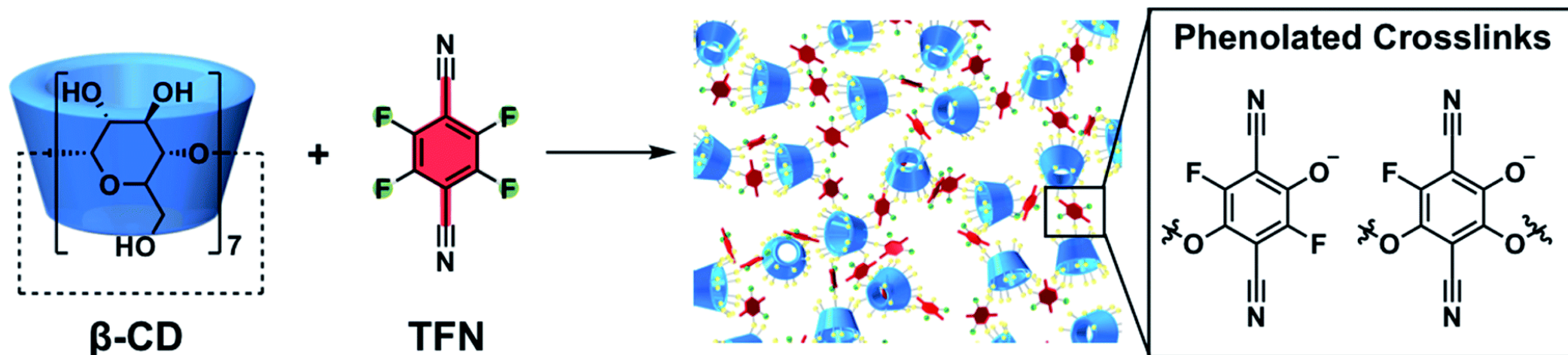
Non covalent attachment to graphene

- Remove micropollutants from water



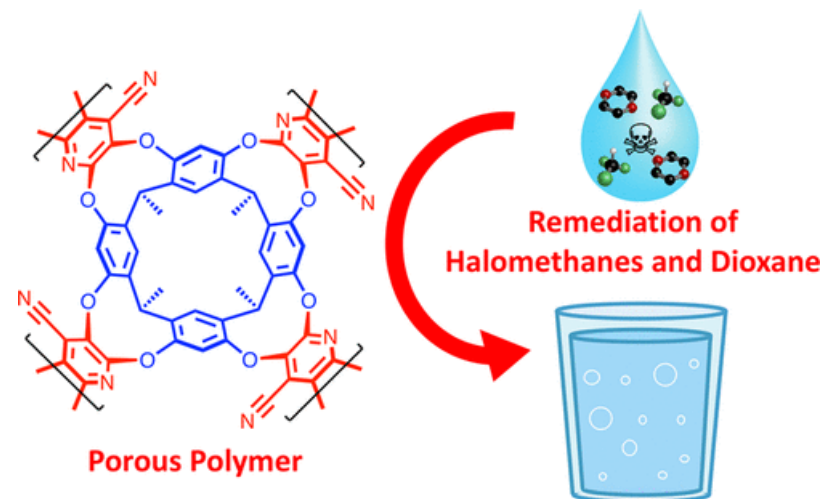
M. Tagliavini, A. Schäfer; *J. Hazard. Mater.* **2018**, 353, 514–521

A. Alsaiee, B. Smith, L. Xiao, D. Helbling, W. Dichtel; *Nature* **2016**, 529, 190–194



- Improved yield
- Higher BET surface (346 ± 113)
- Adsorbent for Pb^{2+} ions
- Adsorbent for 83 MPs

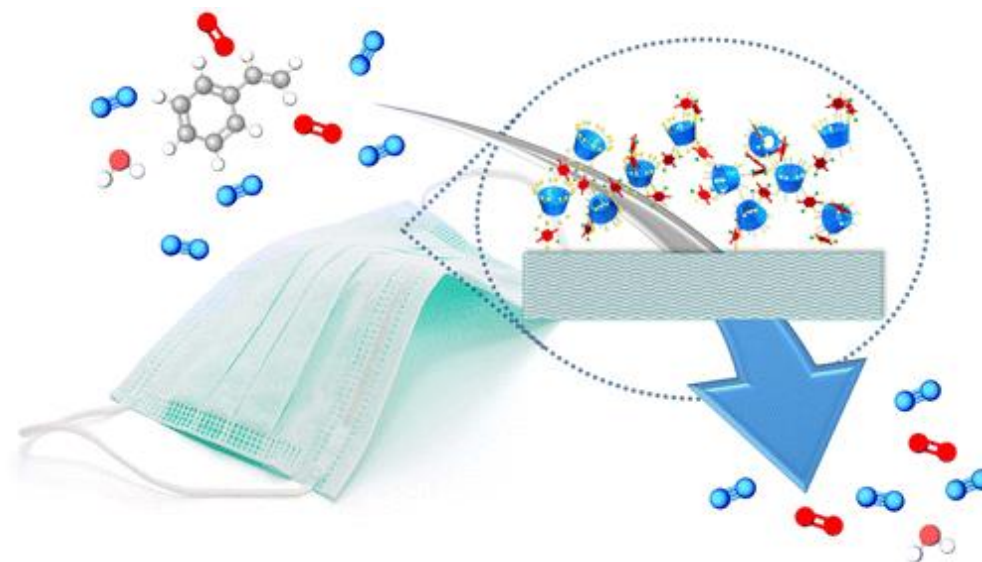
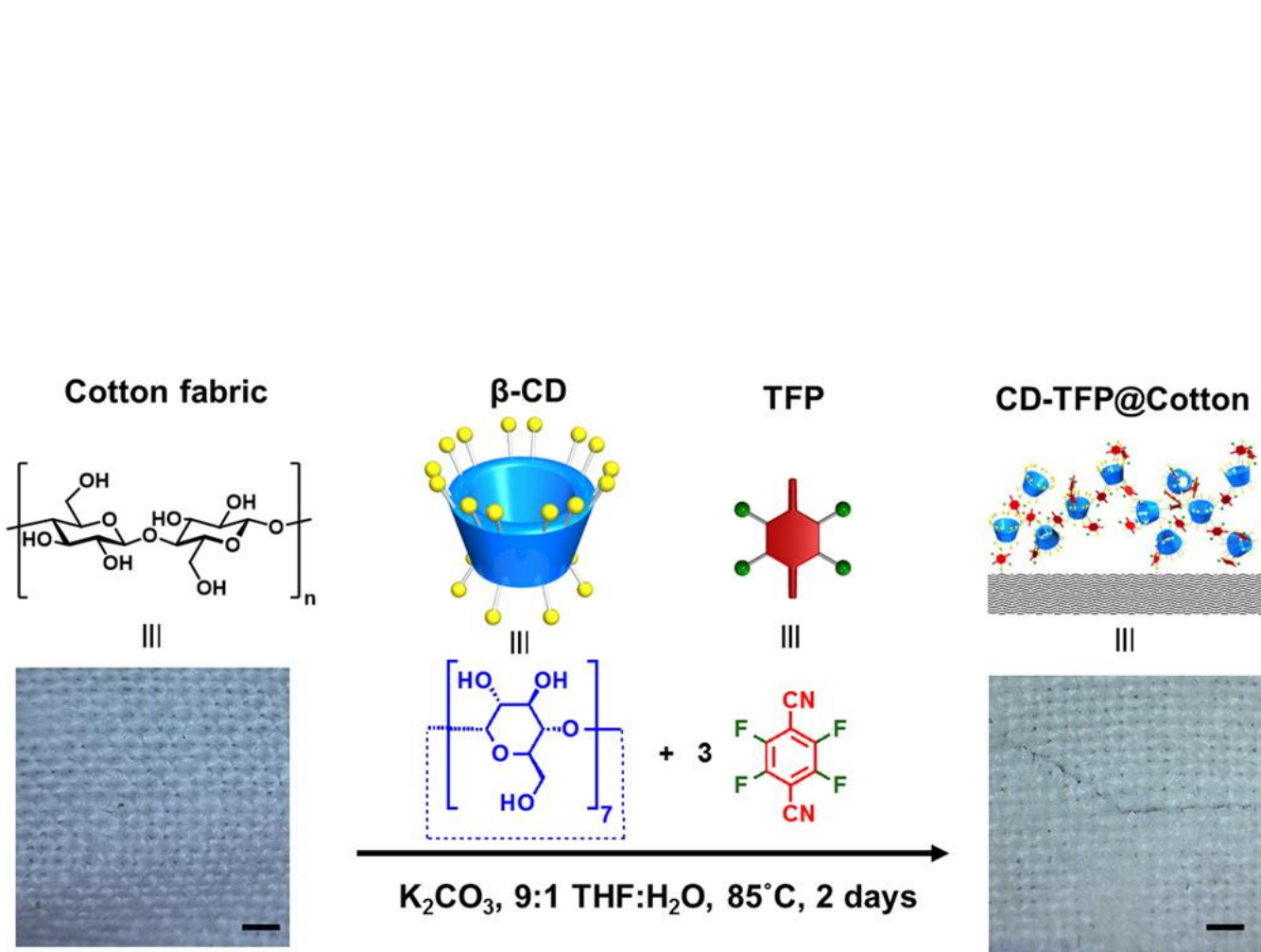
cyclopure



M. Klemes, Y. Ling, M. Chiapasco, A. Alsbaiee, D. Helbling, W. Dichtel; *Chem. Sci.*, **2018**, 9, 8883–8889

L. Skala, A. Yang, M. Klemes, L. Xiao, W. Dichtel; *J. Am. Chem. Soc.* **2019**, 141, 13315–13319

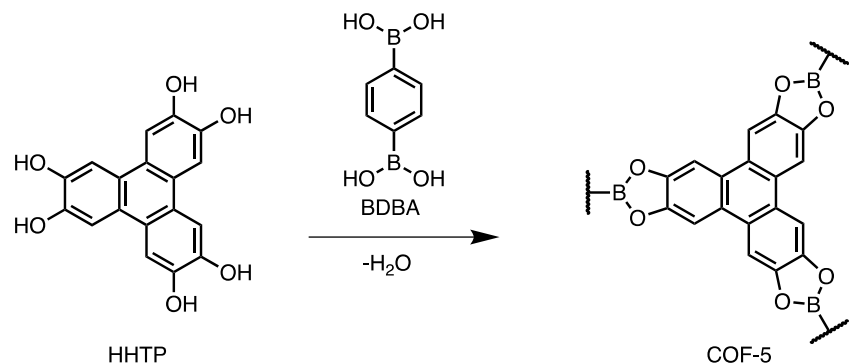
[Cyclopure website](#)



M. Tagliavini, A. Schäfer; *J. Hazard. Mater.* **2018**, 353, 514–521

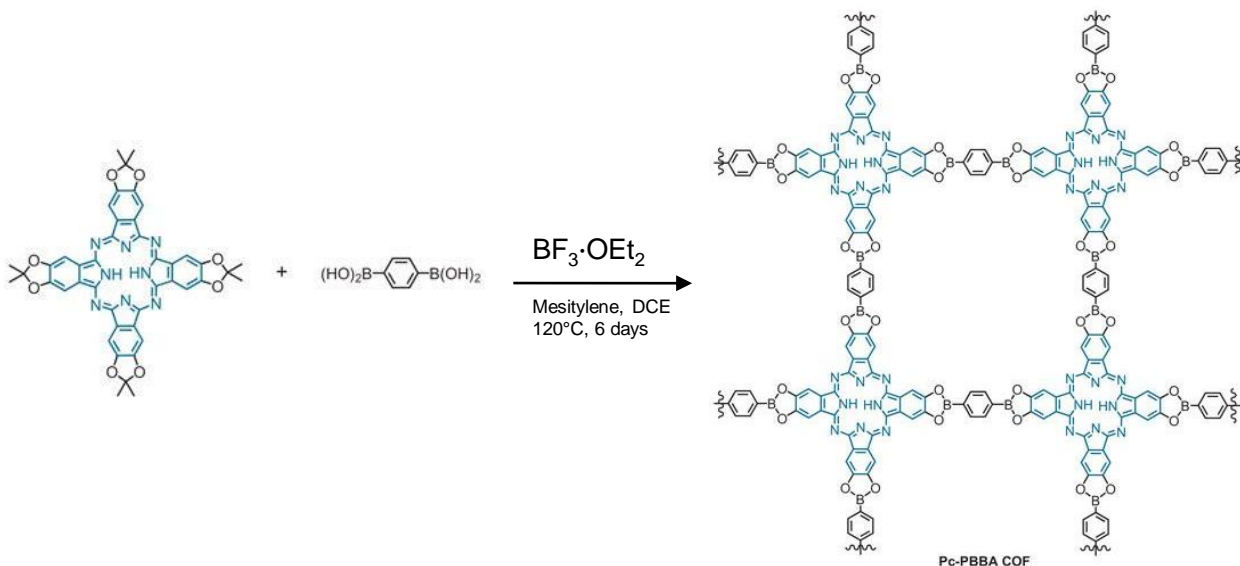
A. Alsaiee, B. Smith, L. Xiao, D. Helbling & W. Dichtel; *Nature* **2016**, 529, 190–194

- COF formation by condensation (by Yaghi)



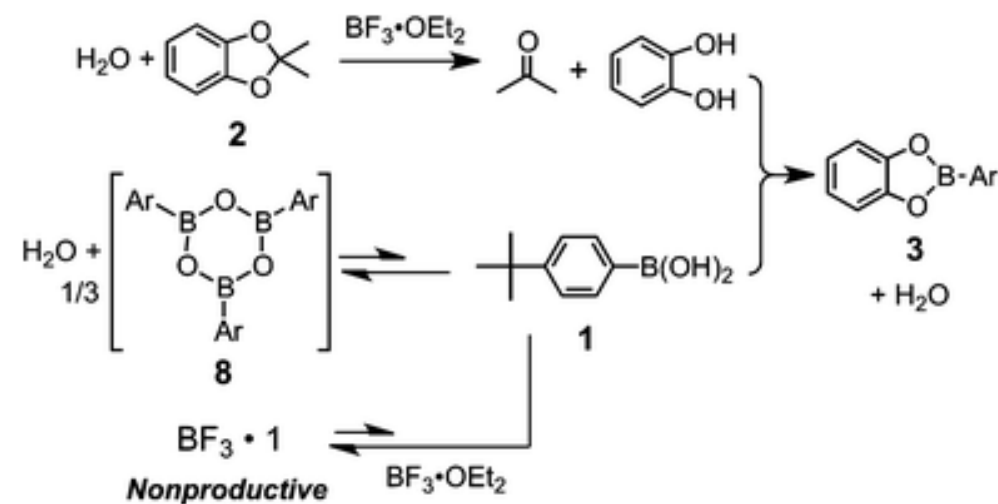
A. Côté, A. Benin, N. Ockwig, O. Yaghi; *Science* **2005**, *310*, 1166–1170

- Lewis acid-catalyzed COF formation



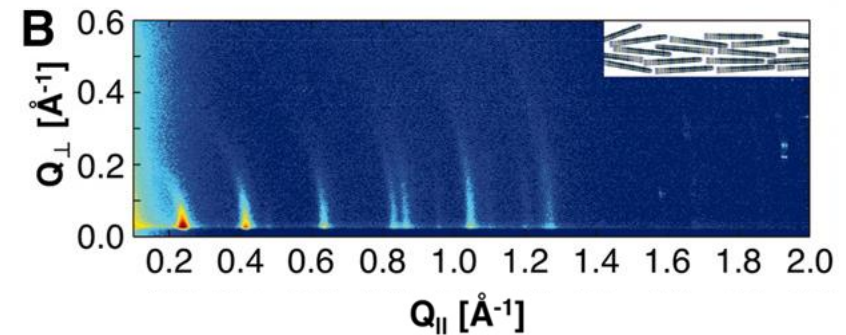
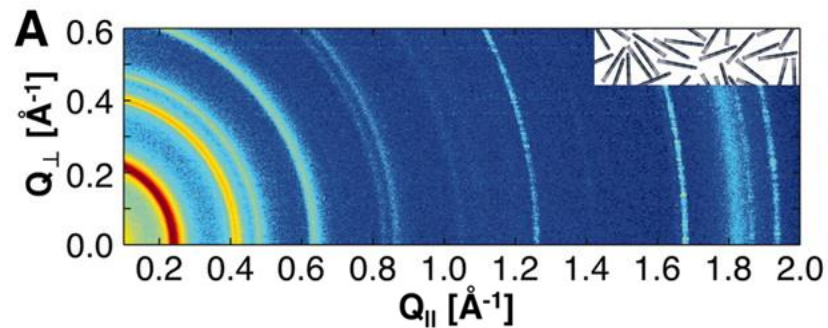
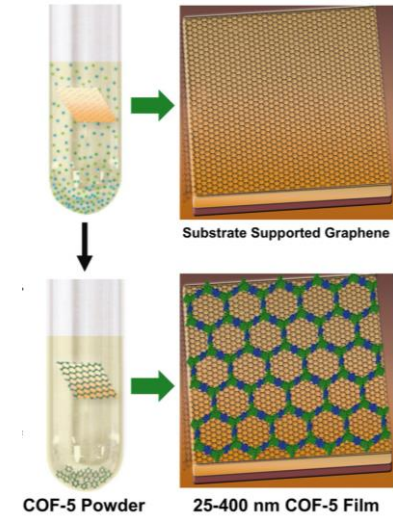
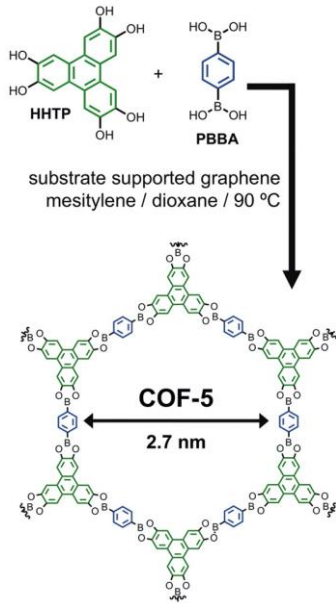
E. Spitler, W. Dichtel; *Nature Chemistry* **2010**, *2*, 672–677

- Mechanistic study of Lewis acid-catalyzed COF formation

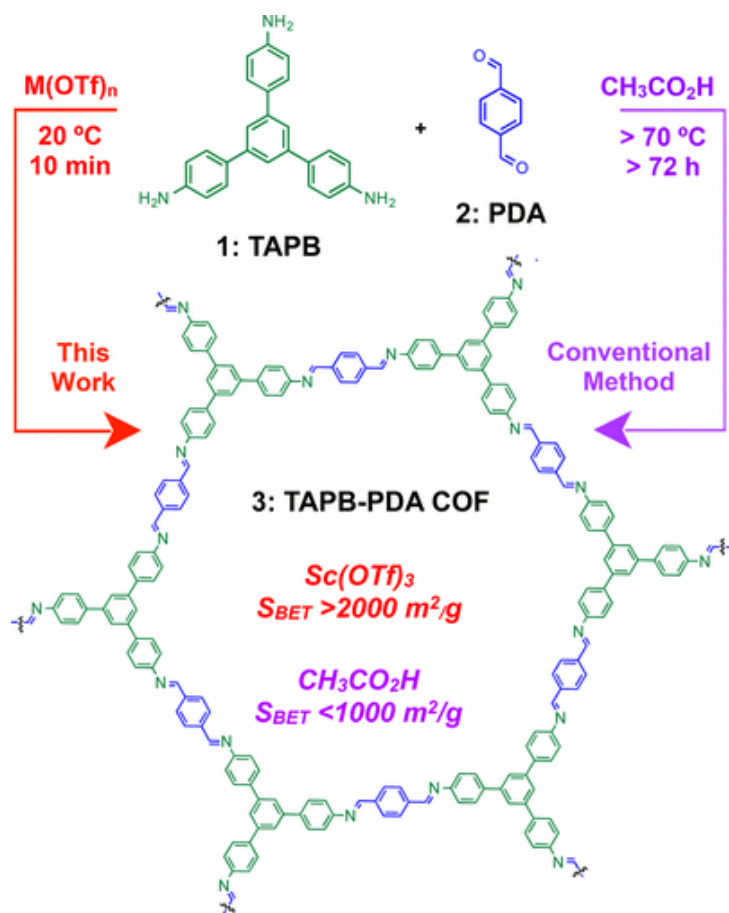


E. Spitler, M. Giovino, W. Dichtel; *Chem. Sci.* **2011**, *2*, 1588–1593

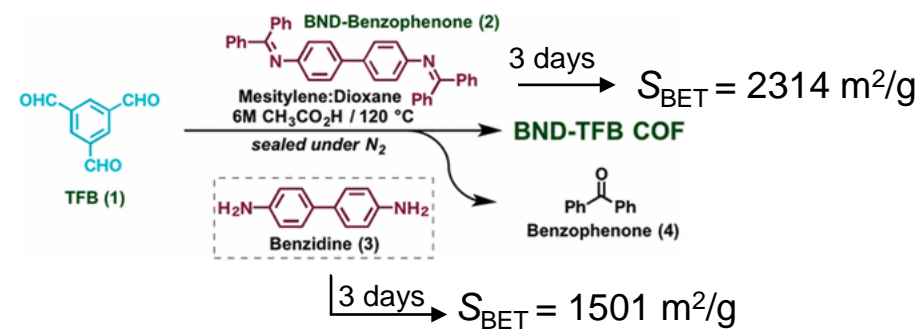
- Oriented 2D COF films on Single-Layer Graphene



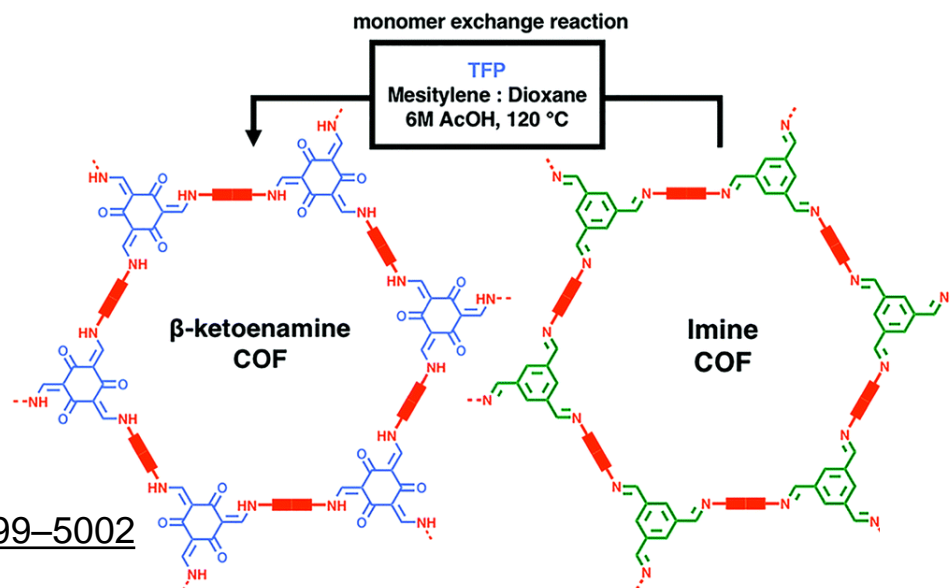
- Metal-catalyzed COF formation



- Benzophenone-based COF formation

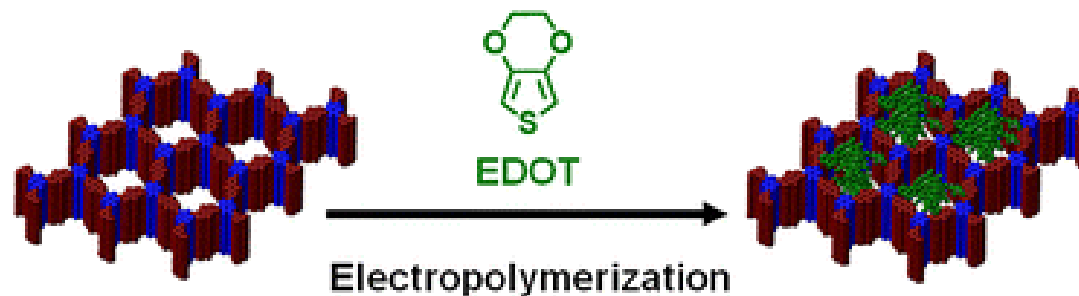
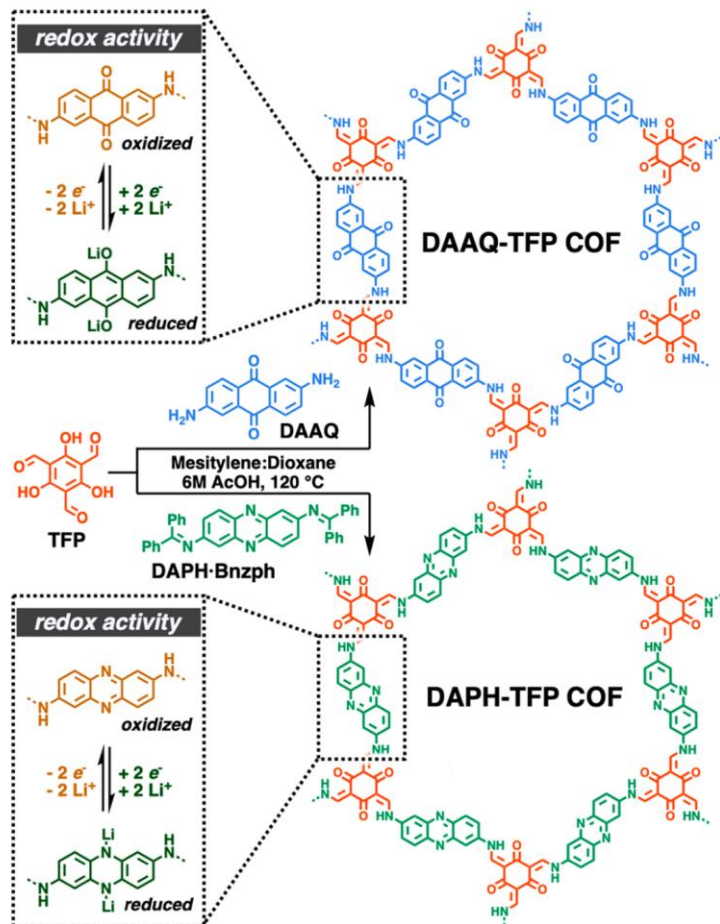


- Monomer exchange reaction



M. Matsumoto, R. Dasari, W. Ji, W. Dichtel; *J. Am. Chem. Soc.* **2017**, *139*, 4999–5002

E. Vitaku, W. Dichtel; *J. Am. Chem. Soc.* **2017**, *139*, 12911–12914

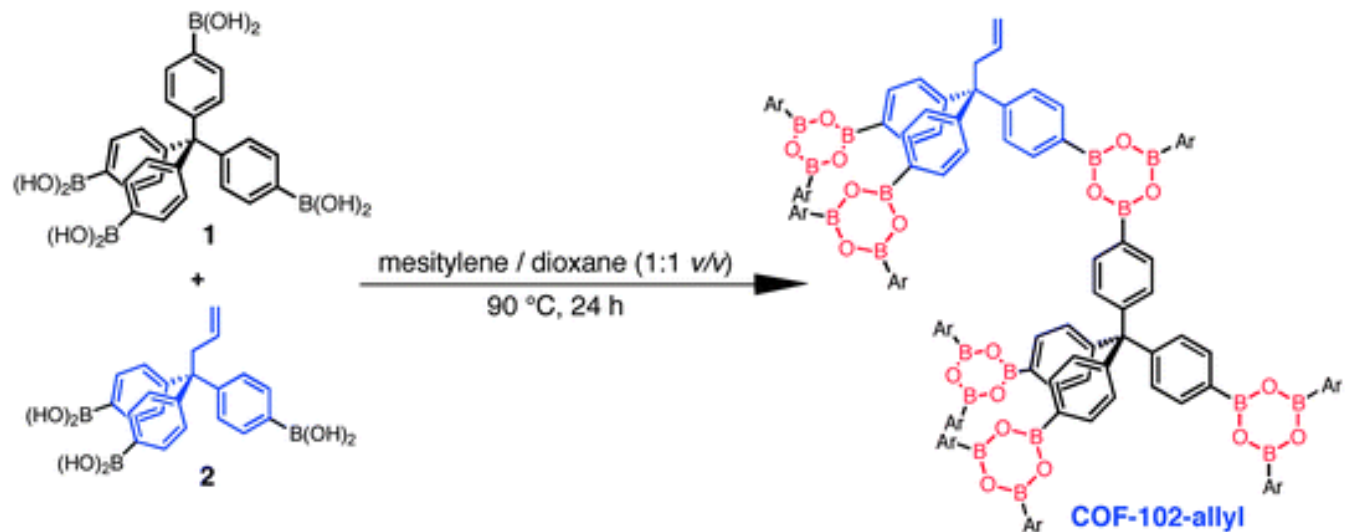


property	DAAQ-TFP	DAPH-TFP
S_{BET} [m ² /g]	1140	1155
conductivity ^a [S/cm]	4.4×10^{-5}	4.8×10^{-5}
Li ⁺ diffusion coefficient [cm ² /s]	1.6×10^{-10}	1.1×10^{-9}
capacitance [F/g]	95	167
capacity at 0.5 C [mAh/g]	53.5	81.7
capacity retention at 20 C ^b	31%	60%

C. Mulzer, L. Shen, R. Bisbey, J. McKone W. Dichtel; *ACS Cent. Sci.* **2016**, *2*, 667–673

E. Vitaku, C. Gannett, K. Carpenter, W. Dichtel; *J. Am. Chem. Soc.* **2020**, *142*, 16–20

- Formation of 3D COFs



- Postsynthetic functionalization

