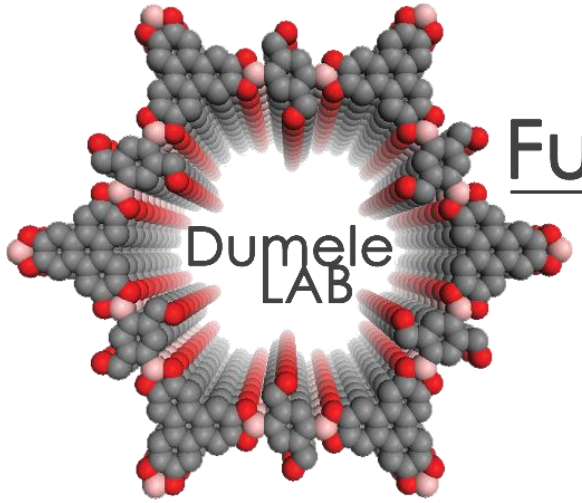


Functional Framework Materials
by organic synthesis

MORIN GROUP
RESEARCH GROUP
ON ORGANIC
NANOMATERIALS

Literature Talk

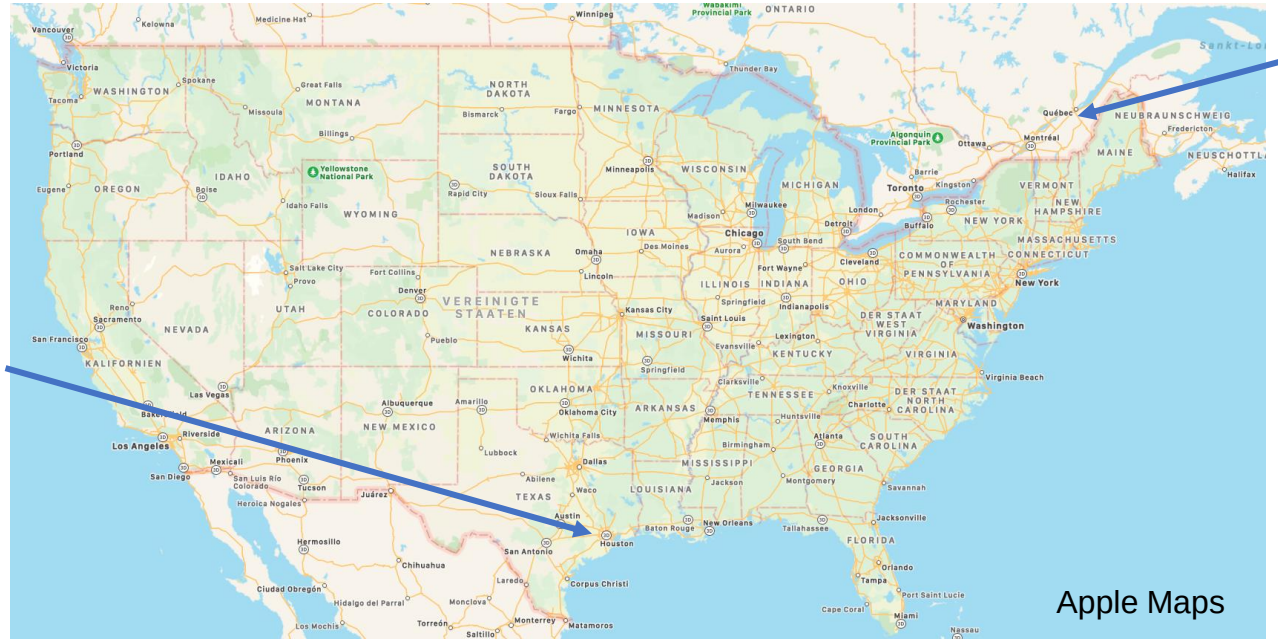
Prof. Jean-François Morin

16.11.2020

Sebastian M. Pallasch

Prof. Morin

- 2000 B.Sc. in Chemistry, Université Laval, Québec, Canada
- 2004 Ph.D. in Chemistry, Université Laval, Québec, Canada
  Supervisor: Prof. Mario Leclerc
- 2004–2006 Postdoctoral fellow: Rice University, Smalley Institute for Nanoscale Science and Technology, Houston, Texas, USA
- 2006–2011 Assistant Professor, Université Laval, Québec, Canada
- 2011–2015 Associate Professor, Université Laval, Québec, Canada
- 2015–present Professor, Université Laval, Québec, Canada



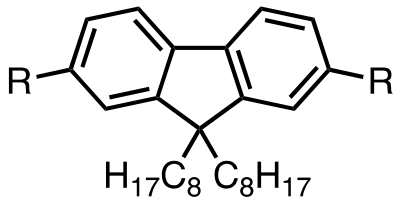
Prof. Morin

- 2000 B.Sc. in Chemistry, Université Laval, Québec, Canada
- 2004 Ph.D. in Chemistry, Université Laval, Québec, Canada
  Supervisor: Prof. Mario Leclerc
- 2004–2006 Postdoctoral fellow: Rice University, Smalley Institute for Nanoscale Science and Technology, Houston, Texas, USA
- 2006–2011 Assistant Professor, Université Laval, Québec, Canada
- 2011–2015 Associate Professor, Université Laval, Québec, Canada
- 2015–present Professor, Université Laval, Québec, Canada

- 89 Publications, 5 Patents, 4955 Citations
- *h*-Index: 31 (10/2020)

- 4 Awards and Honors (Prix Jeunes diplômés, Professeur étoile)

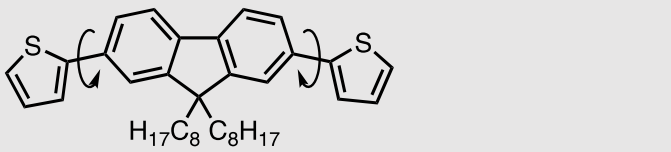
Prof. Morin



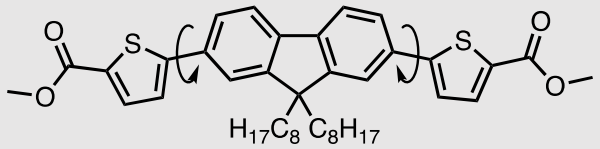
9-Alkyl-2,7-fluorene

Molecule	TFT	TFTE	TFTPE	MTFMT	MTFMTE	MTFMTPE
θ (deg) *	141.0	141.6	-	125.4	126.9	-
λ_A (nm)	354	378	379	337	354	356
λ_F (nm)	386	419	421	386	419	423

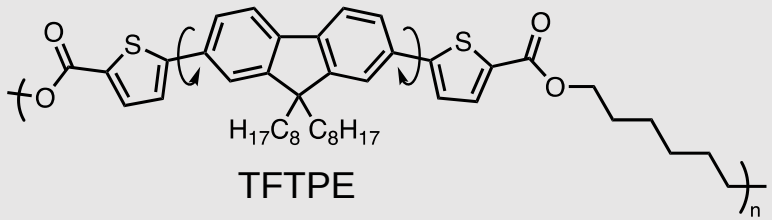
* calculated (HF/6-31G*)



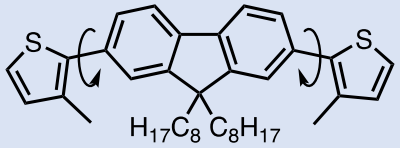
TFT



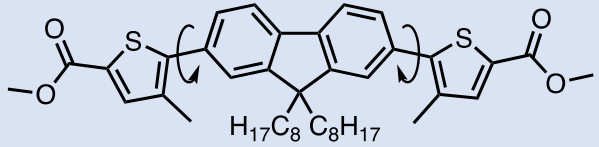
TFTE



TFTPE



MTFMT



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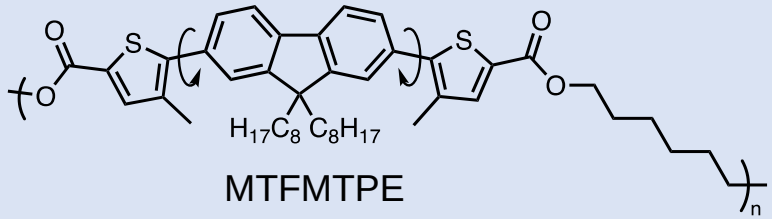
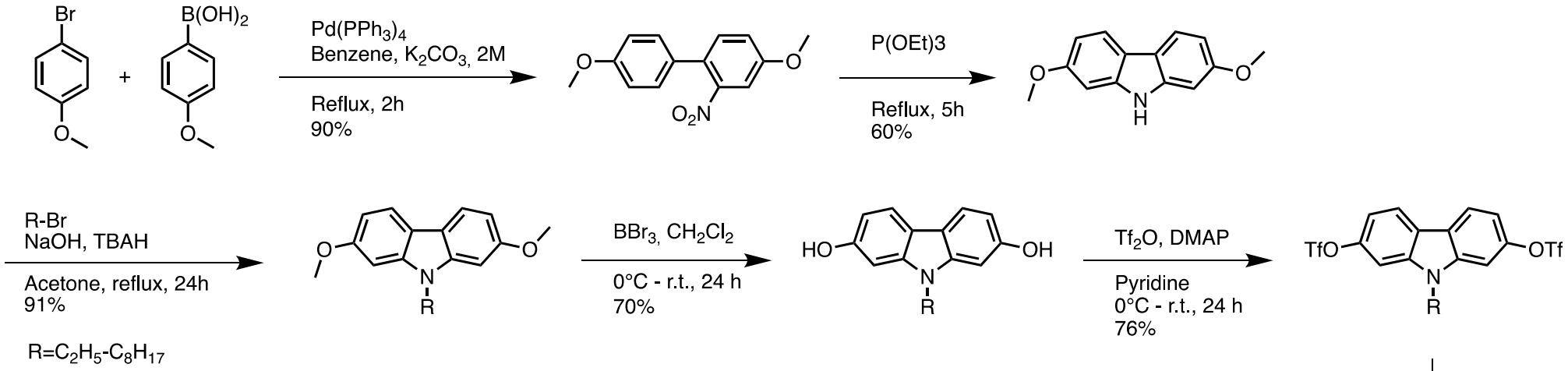


MTFMTPE

M. Belletête, J.-F. Morin, S. Beaupré, M. Lecler, G. Durocher; *Synthetic Metals* **2002** *126*, 43–52

M. Belletête, J.-F. Morin, S. Beaupré, M. Ranger, M. Leclerc, G. Durocher; *Macromolecules* **2001**, *34*, 2288–2297

Prof. Morin



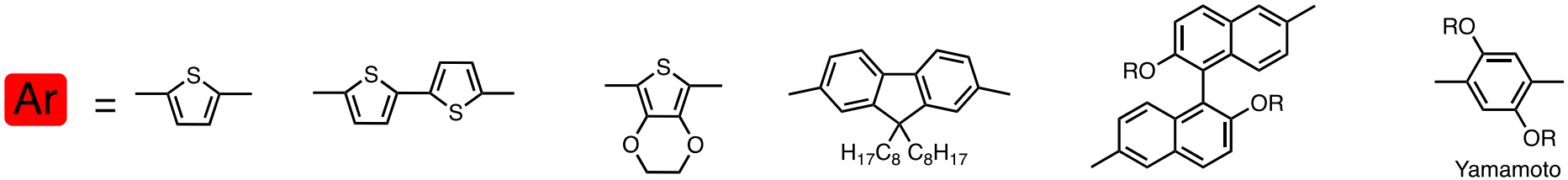
N-Alkyl-2,7-Carbazoles

J.-F. Morin, Mario Leclerc; *Macromolecules* **2001**, *34*, 4680–4682

J.-F. Morin, Mario Leclerc; *Macromolecules* **2002**, *35*, 8413–8417

N. Drolet, J.-F. Morin, Y. Tao, M. Leclerc; *J. Opt. A: Pure Appl. Opt.* **2002**, *4*, S252

Application:
- OLED
- OFET

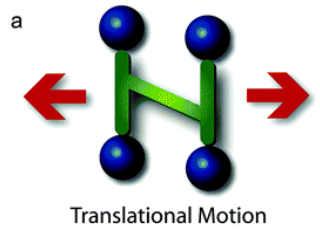


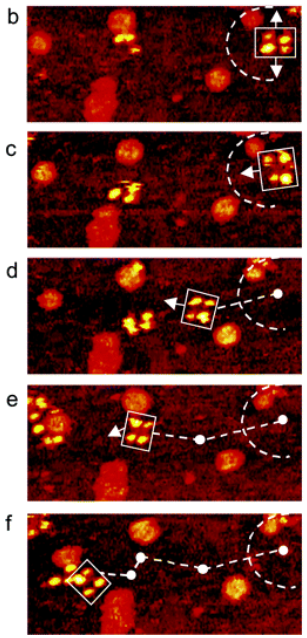
Bachelor and PhD Studies:

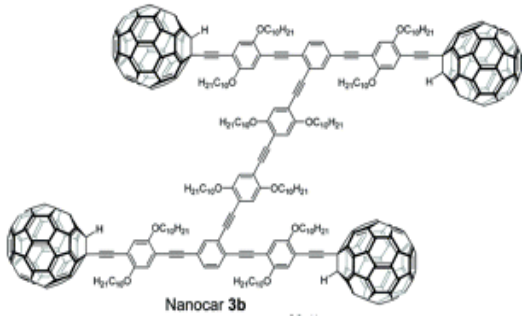
6x Author,
6x Co-author

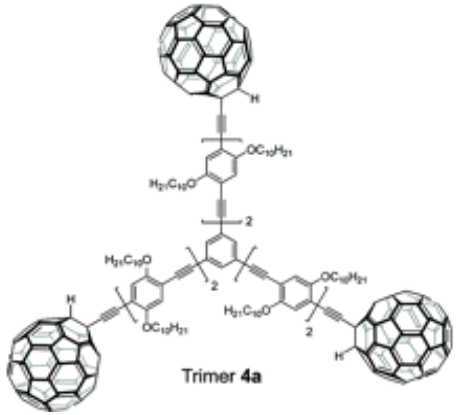
Nanocars:

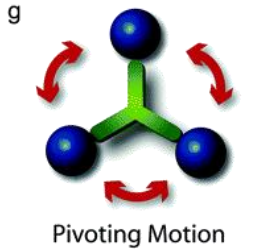
Y. Shirai, A. Osgood, Y. Zhao, …, J.-F. Morin, …,J. M. Tour;
J. Am. Chem. Soc. **2006**, *128*, 4854–4864

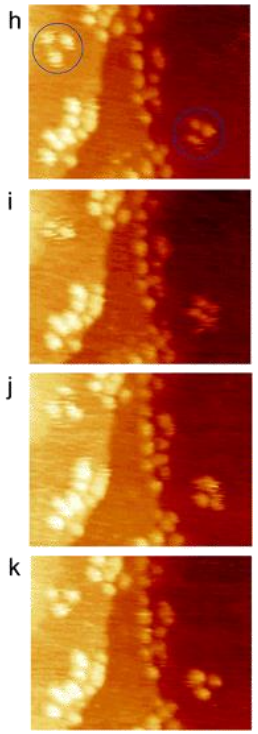






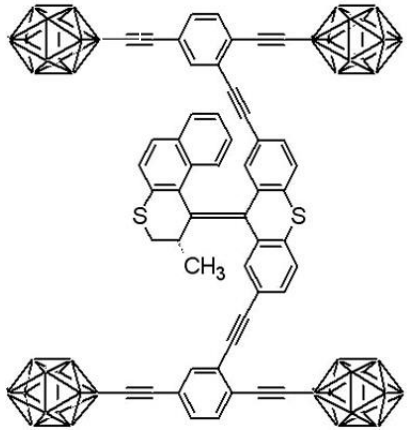


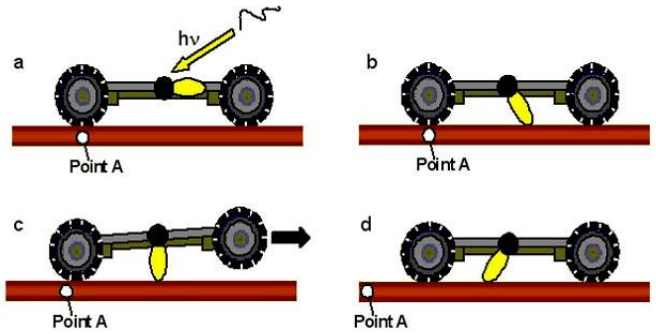




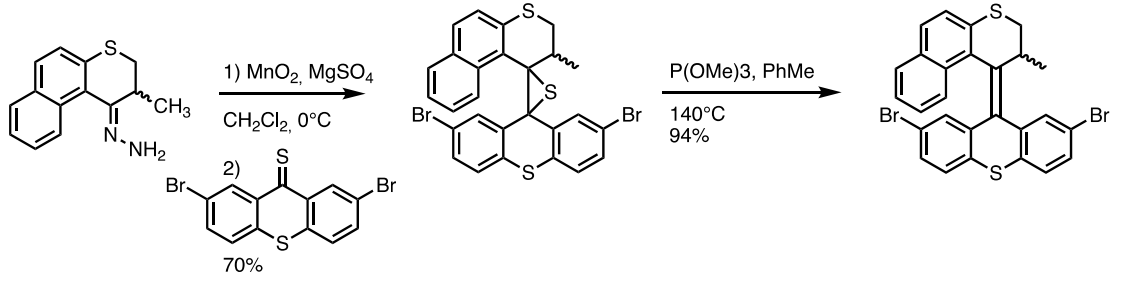
Motorized nanocars:

J.-F. Morin, Y. Shirai, J. M. Tour; *Org. Lett.* **2006**, *8*, 1713–1716





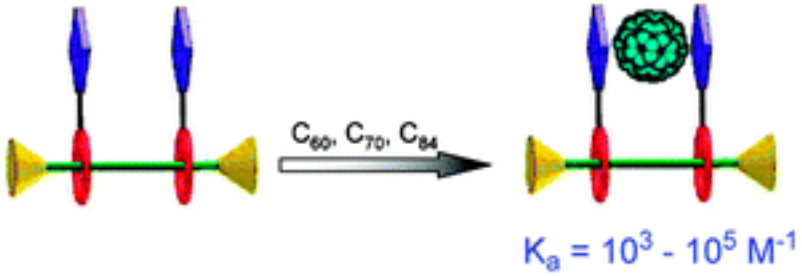
Crucial synthesis steps:

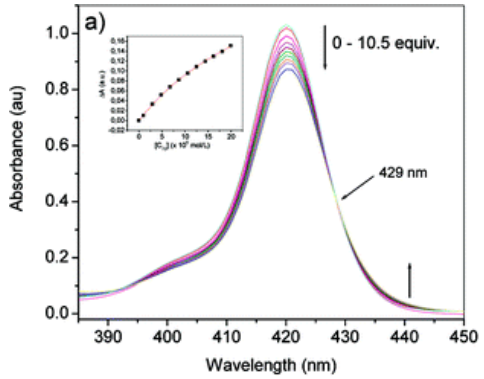


Rotaxanes with supramolecular properties:

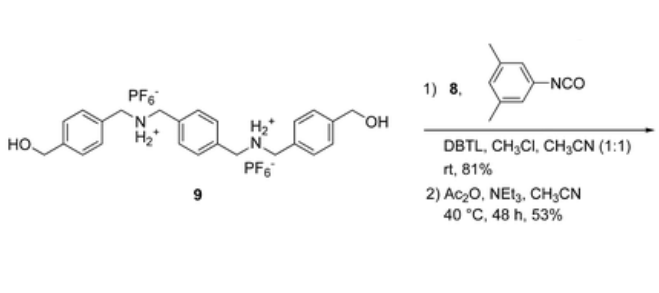
J. Marois, K. Cantin, A. Desmarais, J.-F. Morin; *Org. Lett.* **2008**, *10*, 33–36

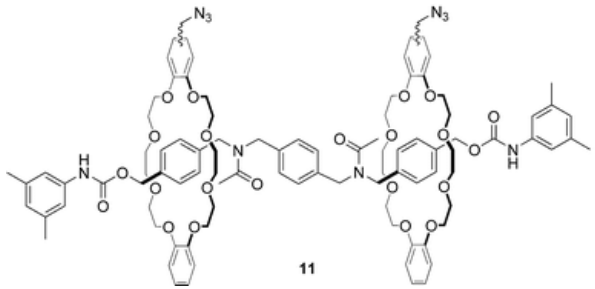
	C_{60}	C_{70}
$K_a(\mathrm{M}^{-1})$, PhMe, 298 K	$4{,}600 \pm 300$	$10{,}100 \pm 900$

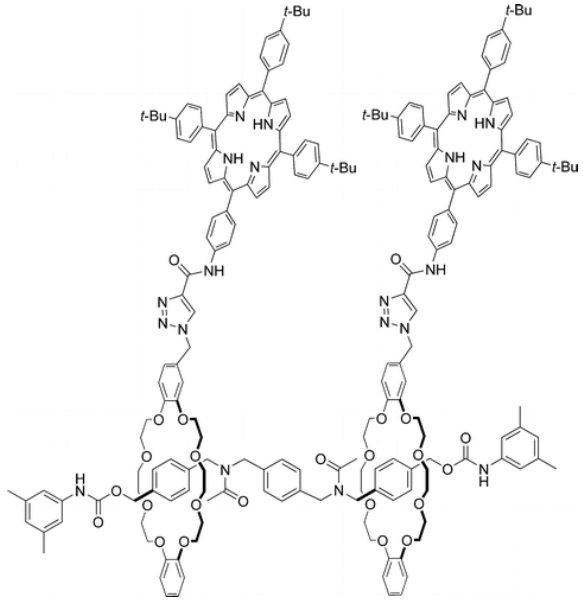




Spectral changes with C70

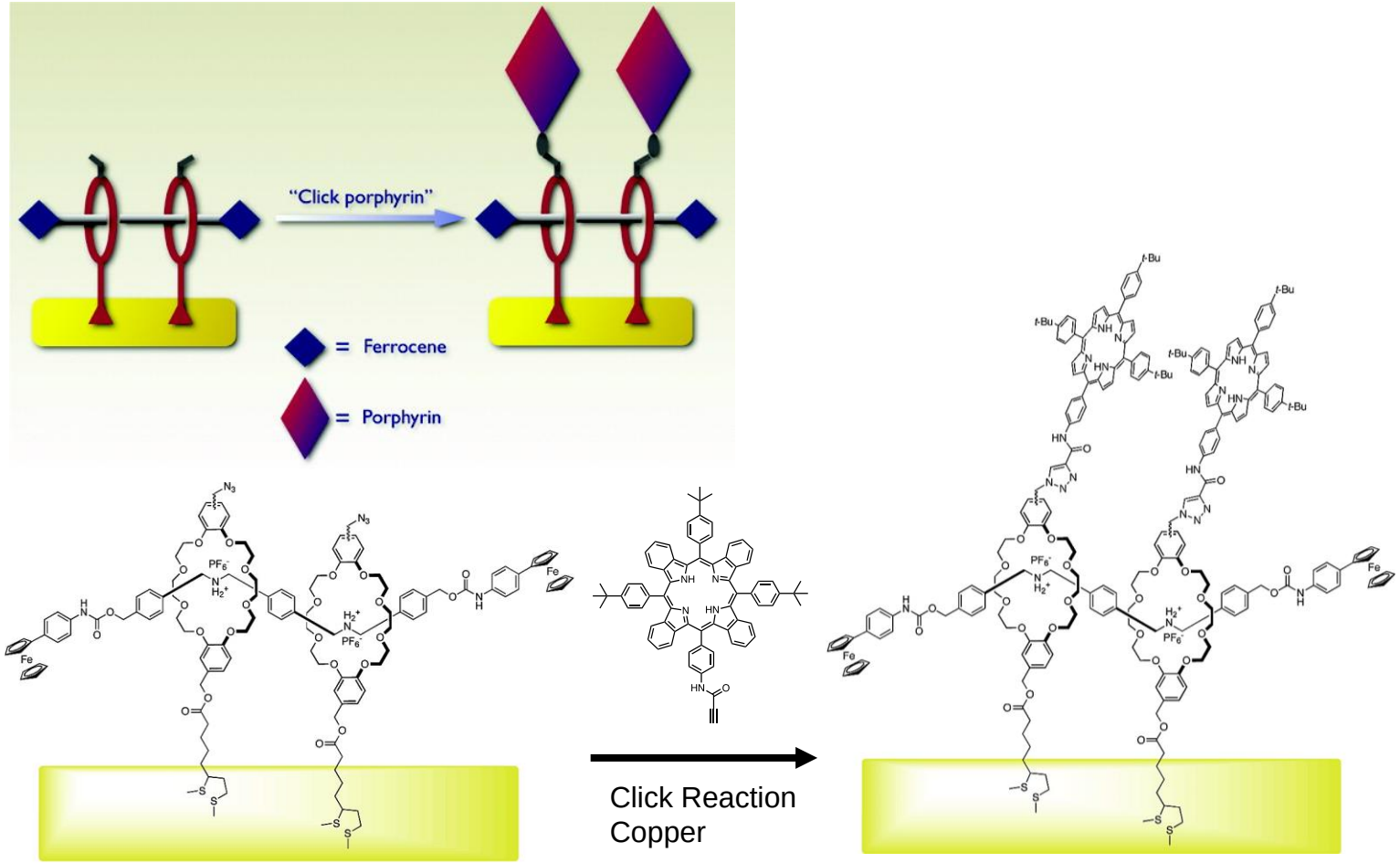






Rotaxanes with supramolecular properties II:

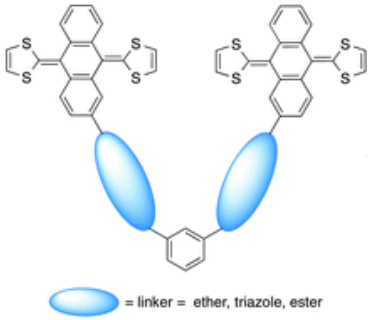
J. Marois, J.-F. Morin; *Langmuir* **2008**, *24*, 10865–10873



„The free-base porphyrin will thus be abandoned for C_{60} complexation purposes.“

Other hosts for C_{60}:

J.-B. Giguèrea, J.-F. Morin; *Org. Biomol. Chem*. **2012**,*10*, 1047–1051



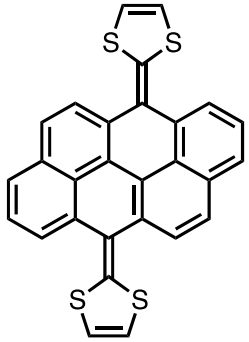
exTTF

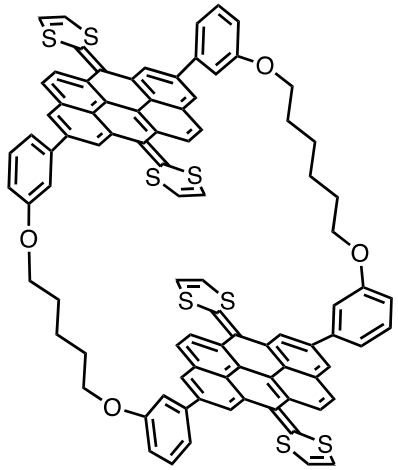
H. Iden, F. Fontaine, J.-F. Morin;
Org. Biomol. Chem., **2014**, *12*, 4117–4123

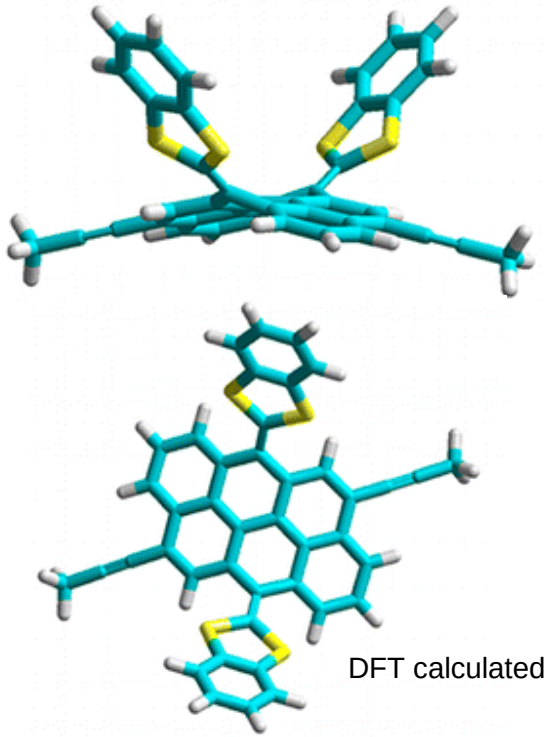
E. Pérez, L. Sánchez, G. Fernández, N. Martín;
J. Am. Chem. Soc. ***2006***, *128*, 7172–7173

exTTF: π-extended tetrathiafulvalene

sExTTF as host for fullerenes:







DFT calculated

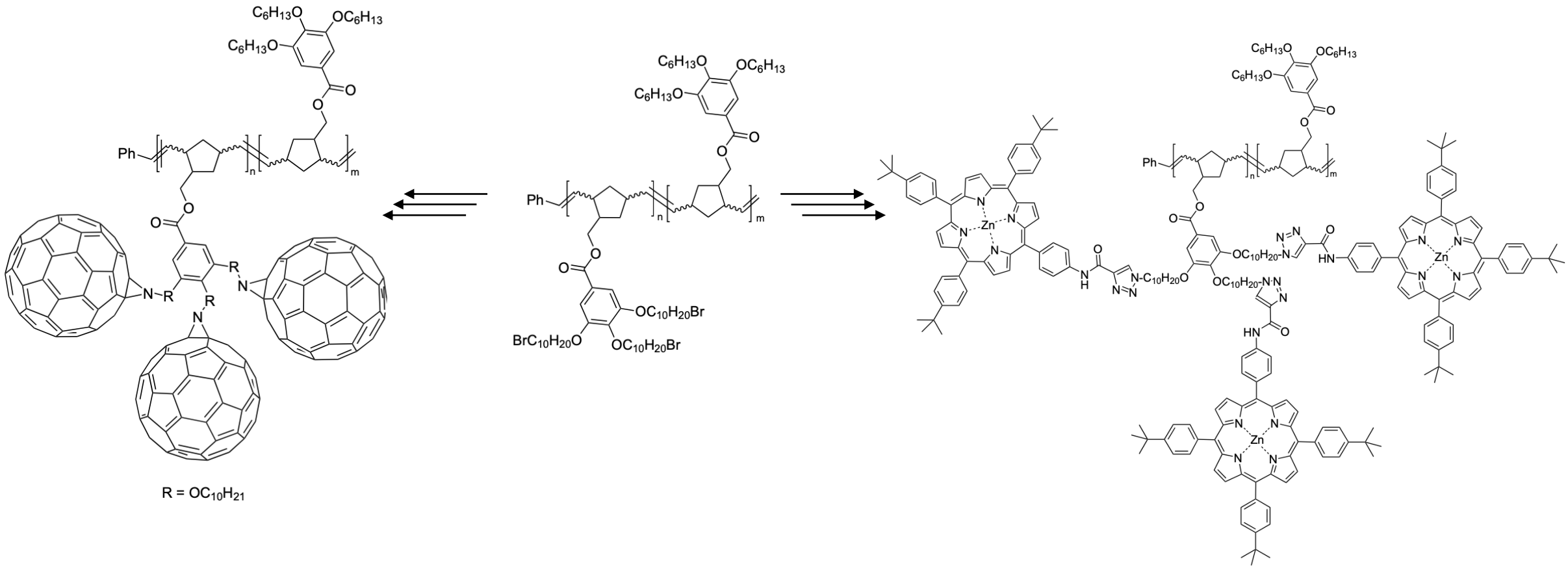
	C_{60}	C_{70}
$K_a(\mathrm{M}^{-1})$	43,000	260,000

PhMe/ACN (2:1), 298 K

J.-B. Giguère; J.-F. Morin; *J. Org. Chem*. **2015**, *80*, 6767–6775

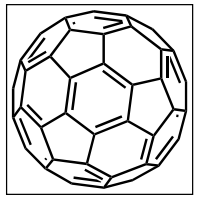
Dendronized diblock copolymers:

E. Fiset, J.-F. Morin; *Polymer* **2009**, *50*, 1369–1377

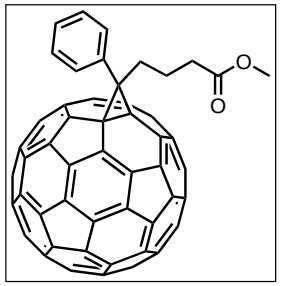


Monosubstituted Fullerenes I:

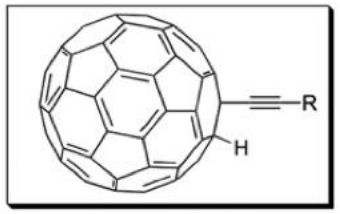
S. Rondeau-Gagne, C. Curutchet, F. Grenier, G. Scholes, J.-F. Morin;
Tetrahedron **2010**, *66,* 4230–4242

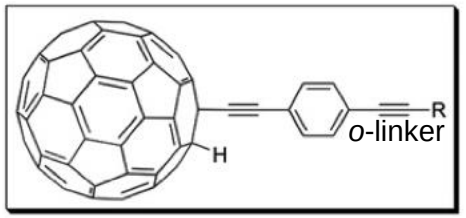


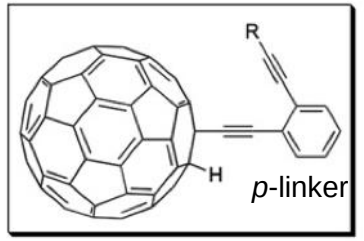
LUMO:
–3.98 eV

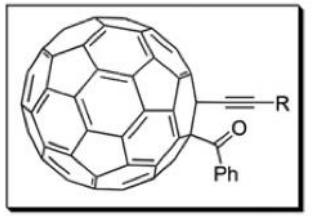


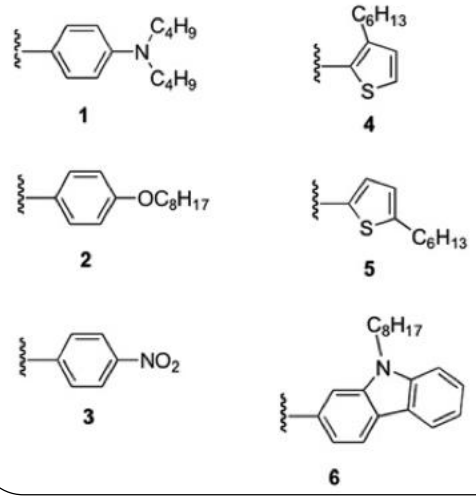
LUMO:
–3.88 eV

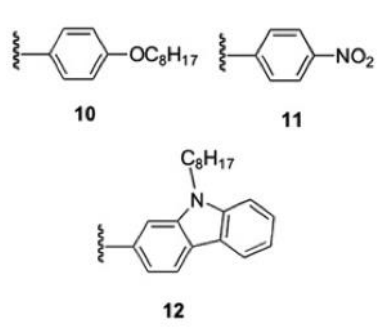


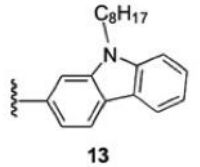








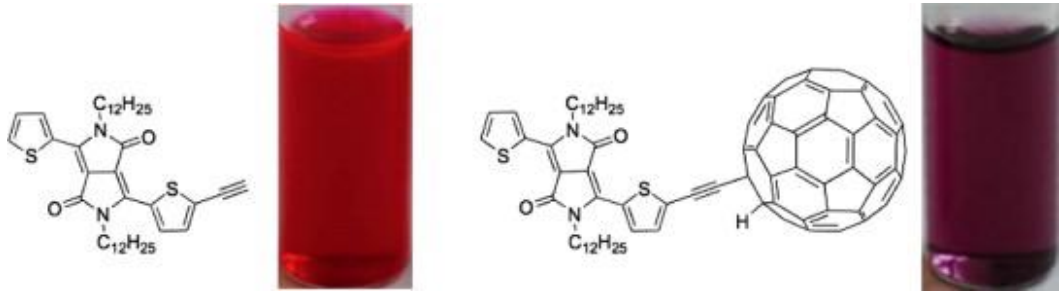




LUMO: –3.92 to –3.96 eV

Monosubstituted Fullerenes II:

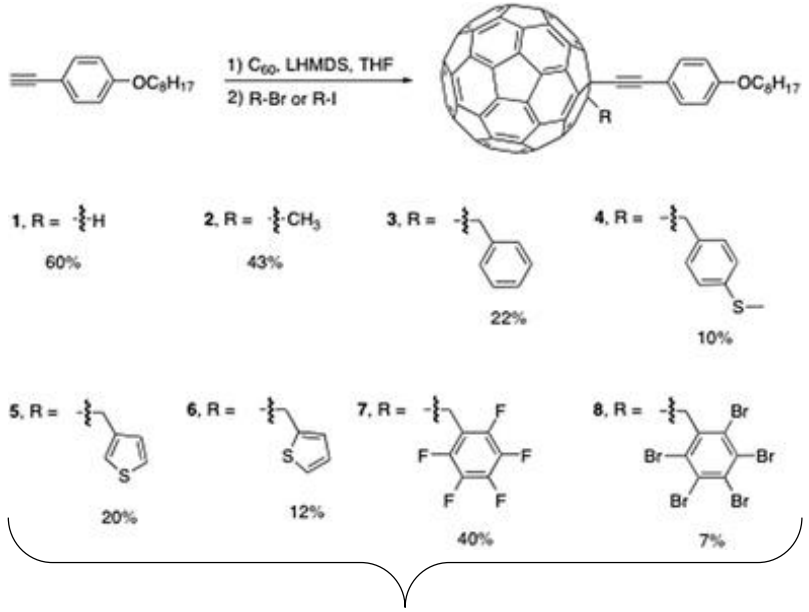
A. Lafleur-Lambert, S. Rondeau-Gagné, A. Soldera, J.-F. Morin;
Tet. Lett. **2011**, *53*, 5008–5011



LUMO [eV]: 3.95 4.08

Disubstituted Fullerenes II:

S. Rondeau-Gagne, A. Lafleur-Lambert, A. Soldera, J.-F. Morin;
New J. Chem. **2011**, *35*, 942–947

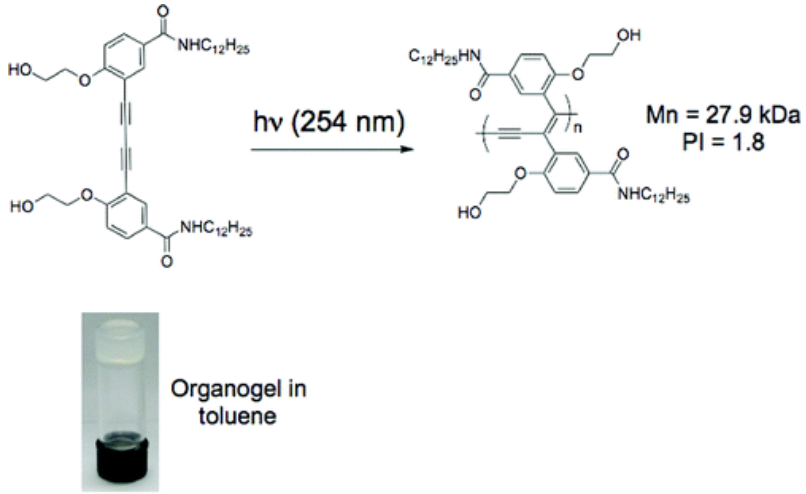


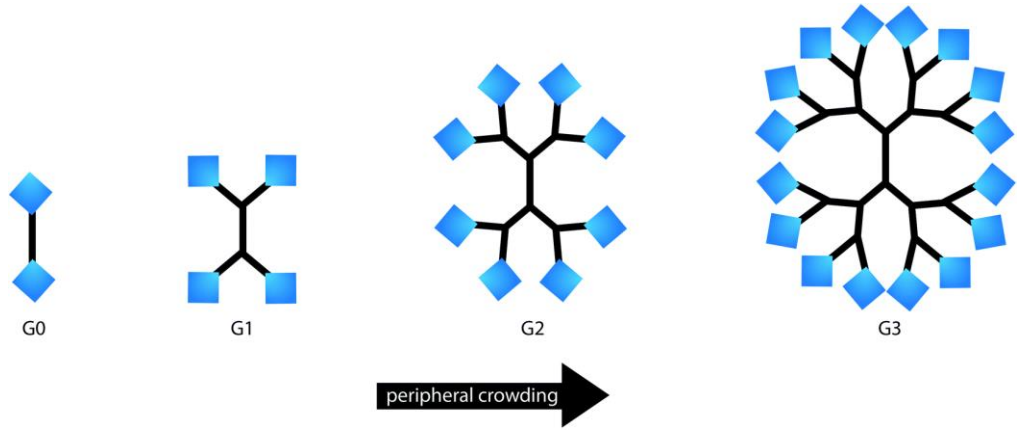
LUMO: –3.87 to –3.96 eV

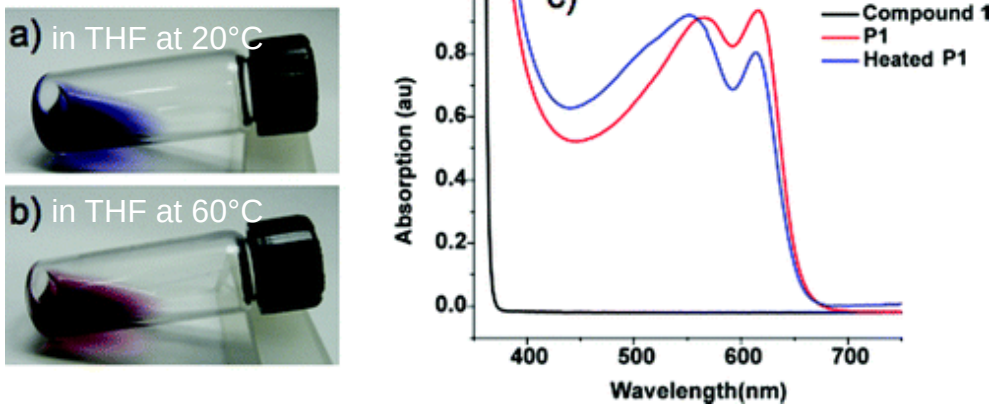
-electron rich groups: decrease of LUMO energy
-electron poor groups: increase of LUMO energy

Topochemical Polymerization

J. Néabo, K. Tohoundjona, J.-F. Morin; *Org. Lett.* **2011**, *13*, 1358–1361



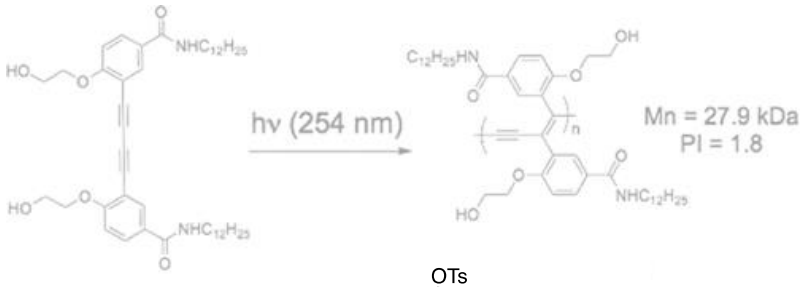


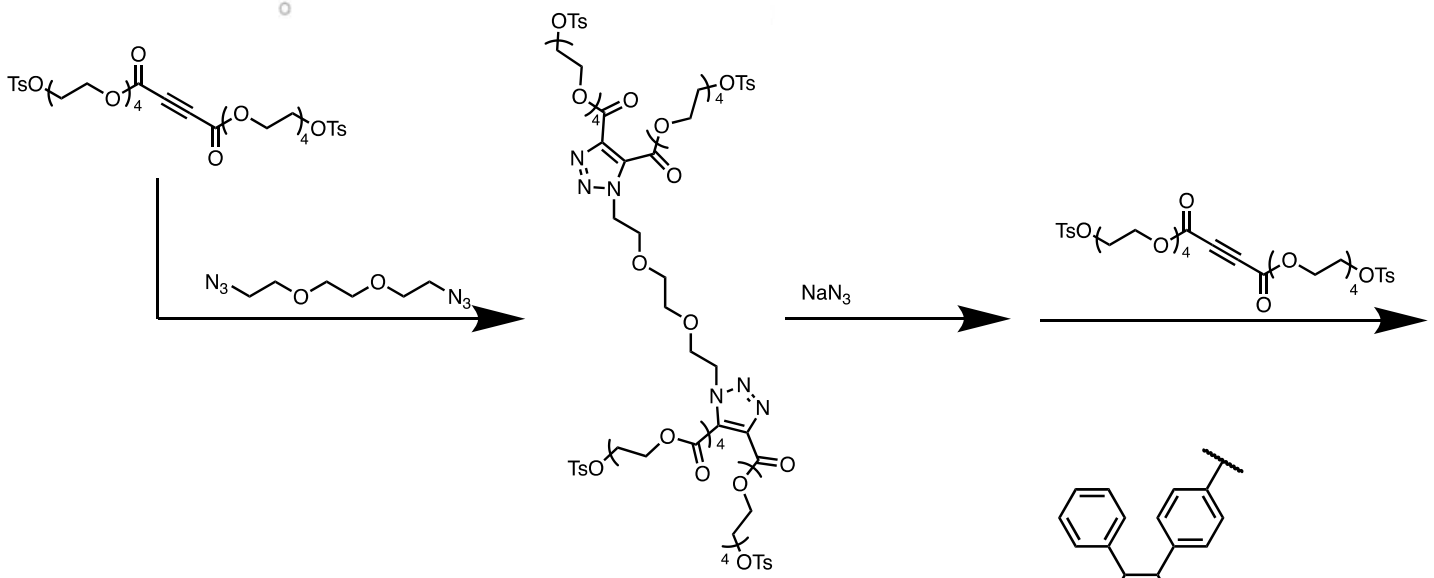


→ reverse thermochromism properties

Topochemical Polymerization

J. Néabo, K. Tohoundjona, J.-F. Morin; *Org. Lett.* **2011**, *13*, 1358–1361

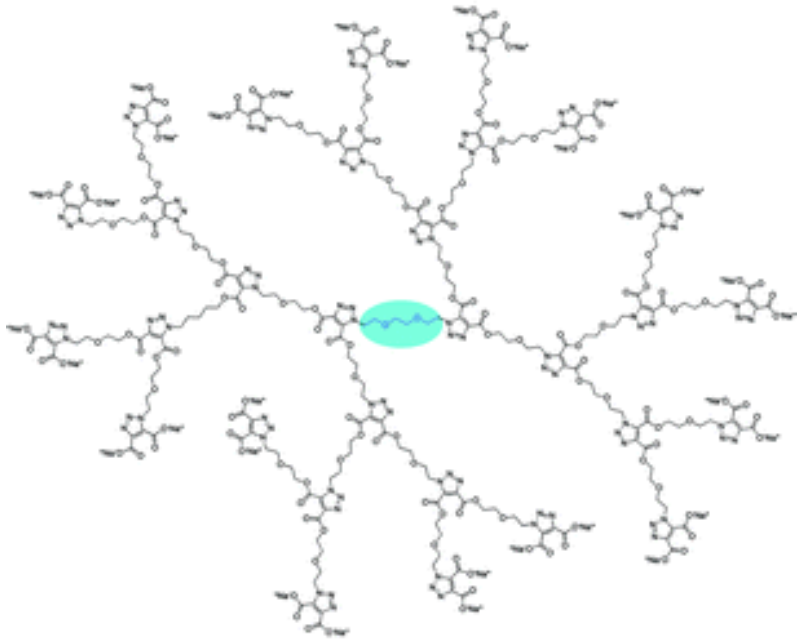


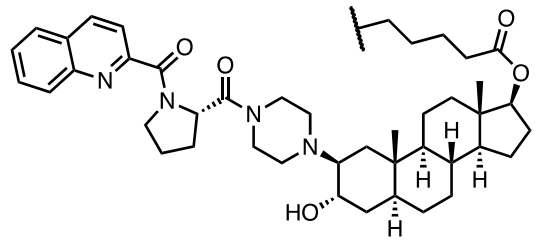


M. Arseneault, N. Leung, L. Fung, R. Hu, J.-F. Morin, B. Tang; *Polym. Chem.* **2014,** *5*, 6087-6096

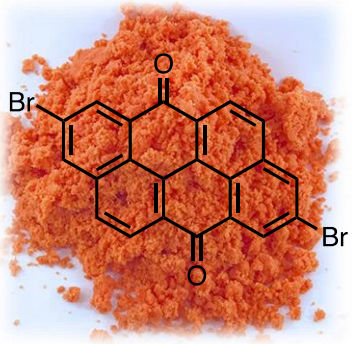
Third and fourth generation dendrimers

M. Arseneault, I. Levesque, J.-F. Morin; *Macromolecules* **2012**, *45*, 3687–3694





P. Darveau, R. Maltais, J. Roy, D. Poirier, J.-F. Morin; *J. Polym. Sci*. **2020**, *58*, 654–661

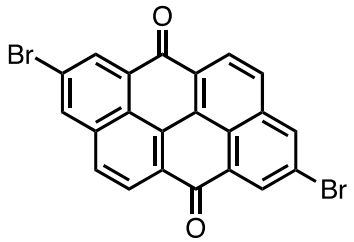


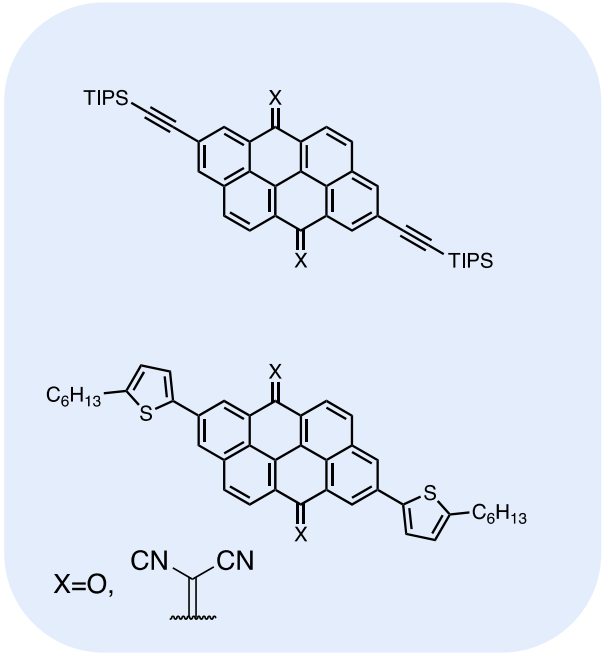
4,10-dibromoanthanthrone

Functionalisation

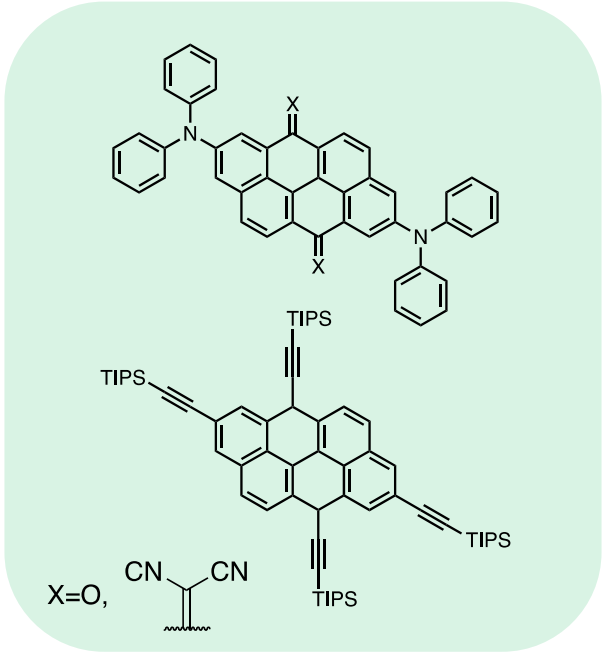
Organic Semiconductors:
-OFETs
-OLEDs
-OPVs
-OSCs

Image of 4,10-dibromoanthanthrone (12.11.2020, 15:32):
https://www.indiamart.com/proddetail/vat-orange-3-20159418997.html

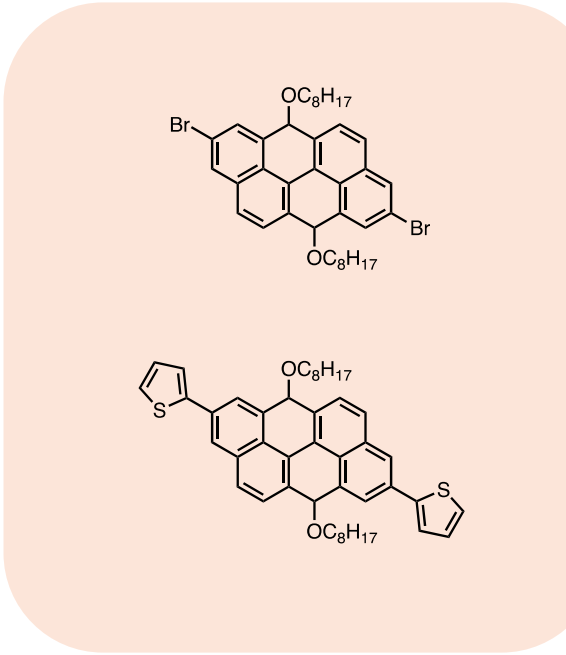




n-Type



Ambipolar

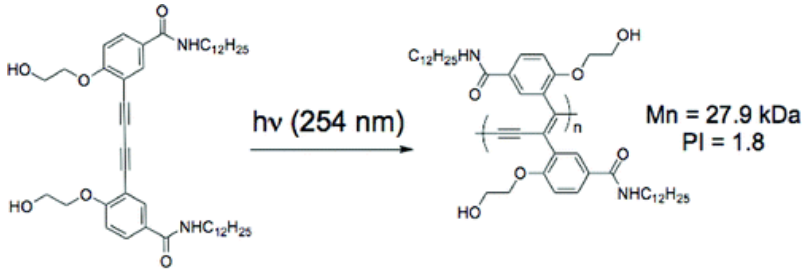


p-Type

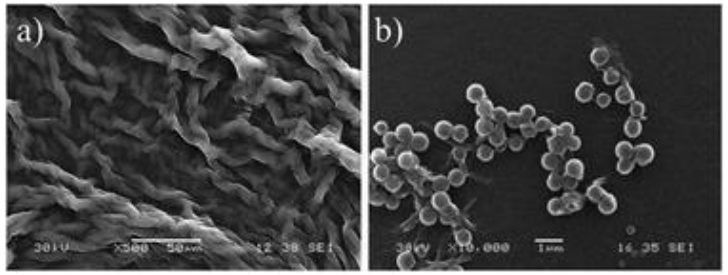
Various Authors, J.F. Morin; *Chem. Eur. J.* **2013**, *19*, 372–381; *J.Org. Chem.* **2013**, *78*, 12769–12778 ; *J. Org. Chem.* **2014**, *79*, 2404–2481; *J. Mater. Chem. C* **2015**, *3*, 601–606

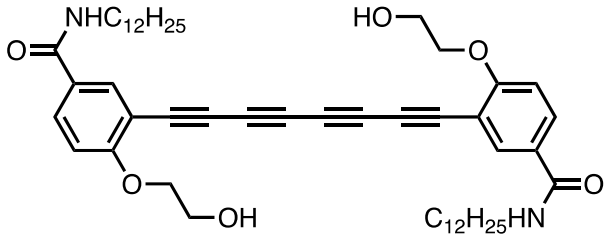
Topochemical Polymerization

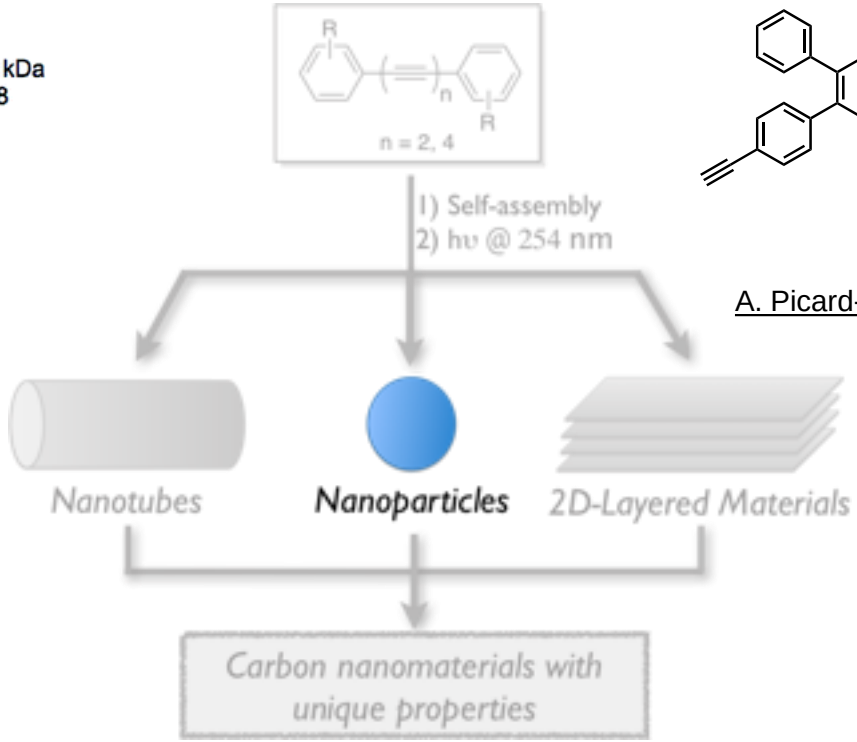
J. Néabo, K. Tohoundjona, J.-F. Morin; *Org. Lett.* **2011**, *13*, 1358–1361



J. Néabo, C. Vigier-Carrière, S. Rondeau-Gagné, J.-F. Morin; *Chem. Commun*. **2012**, *48*, 10144–10146

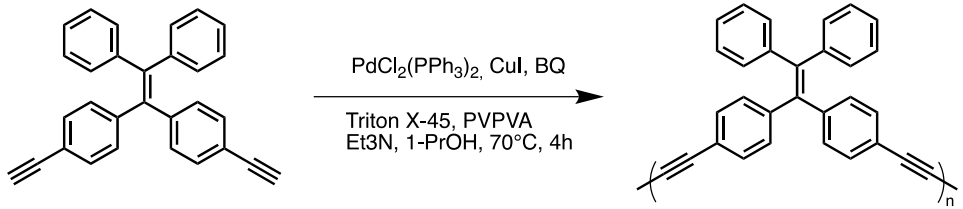




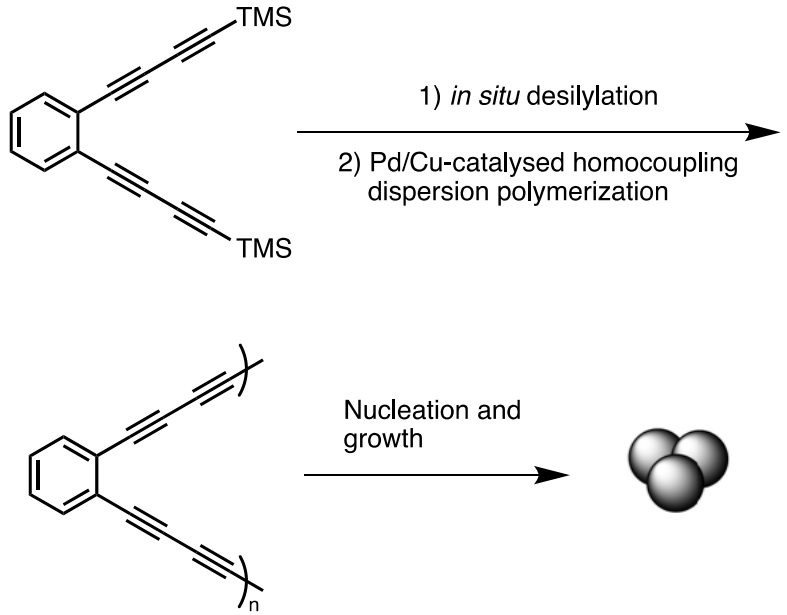


Dispersion Polymerization

A. Picard-Lafond, M. Daiglea, J.-F. Morin; *RSC Adv.* **2017**, **7**, 36132–36137

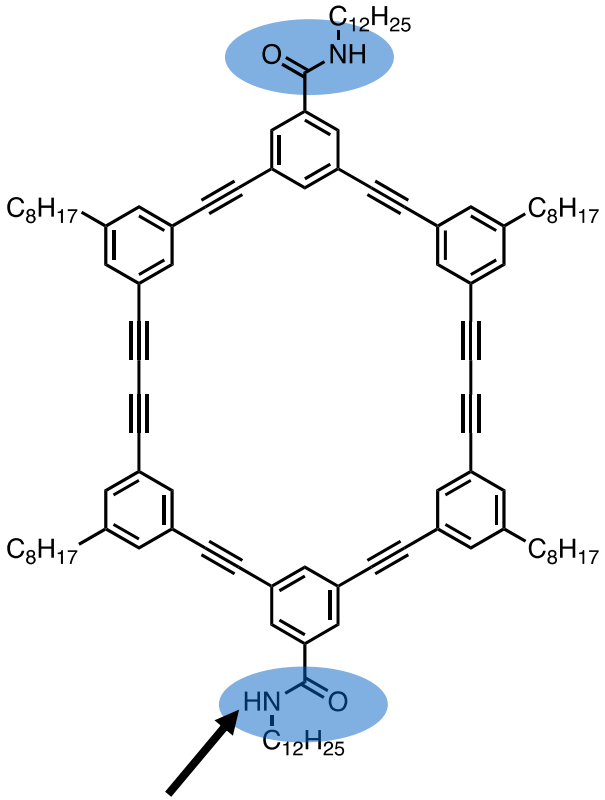


A. Picard-Lafond, J.-F. Morin; *Langmuir* **2017**, *33*, 5385−5392

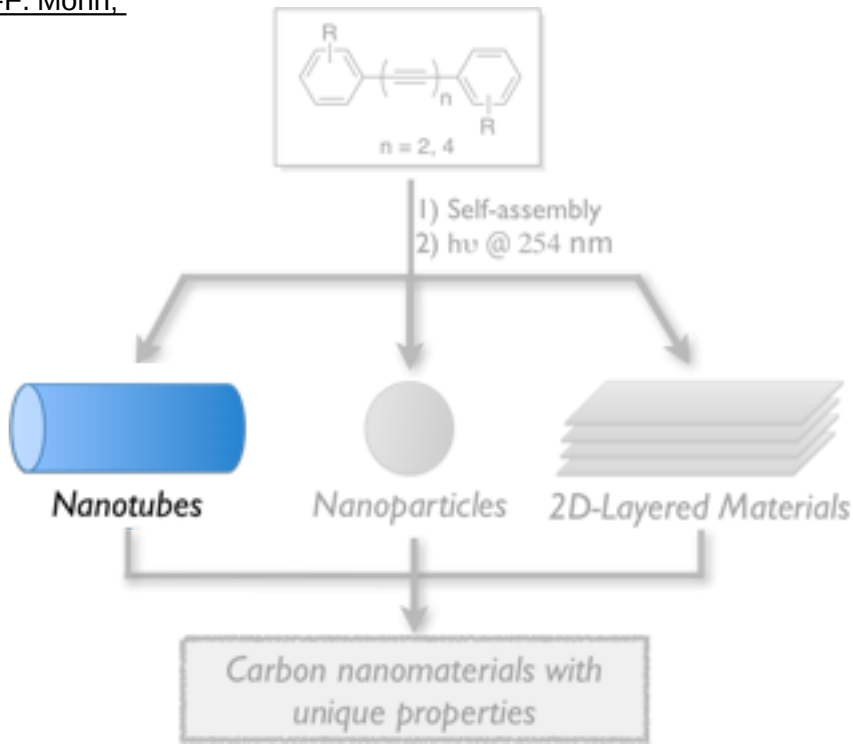


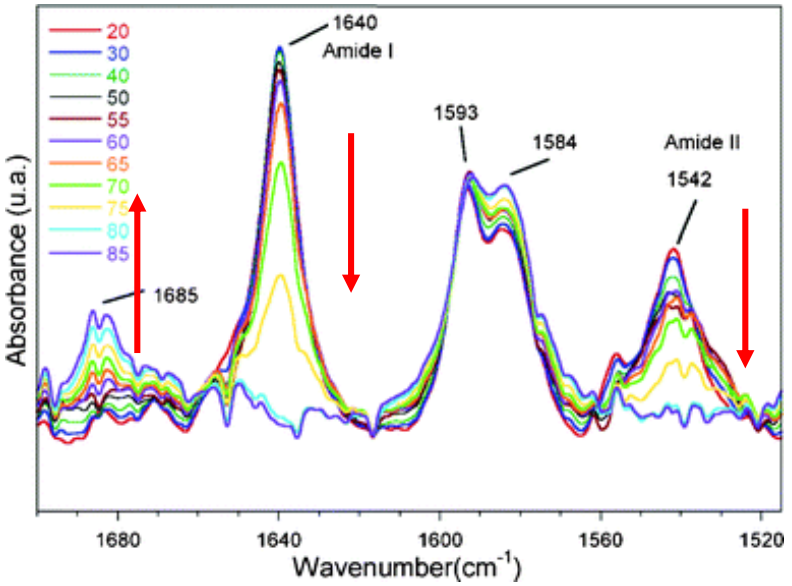
H-Bonding-driven gel formation of PA macrocycles

K. Cantin, S. Rondeau-Gagné, J. Roméo Néabo, M. Daiglea, J.-F. Morin;
Org. Biomol. Chem. **2011**, *9*, 4440–4443



Intermolecular H-bonding

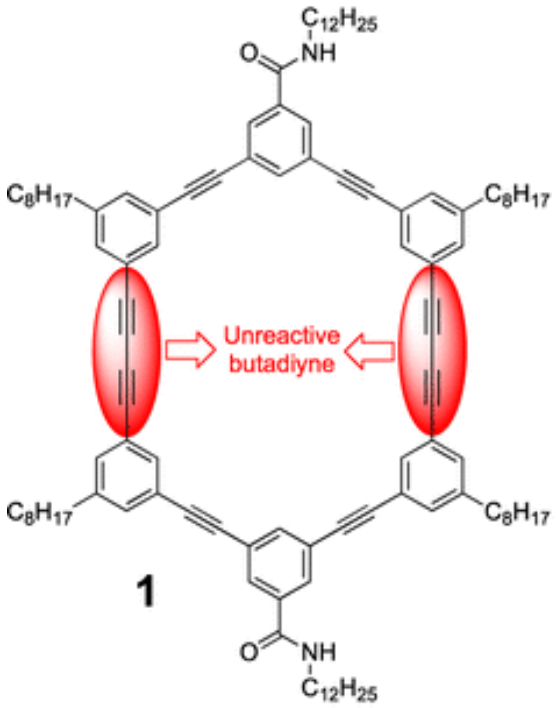


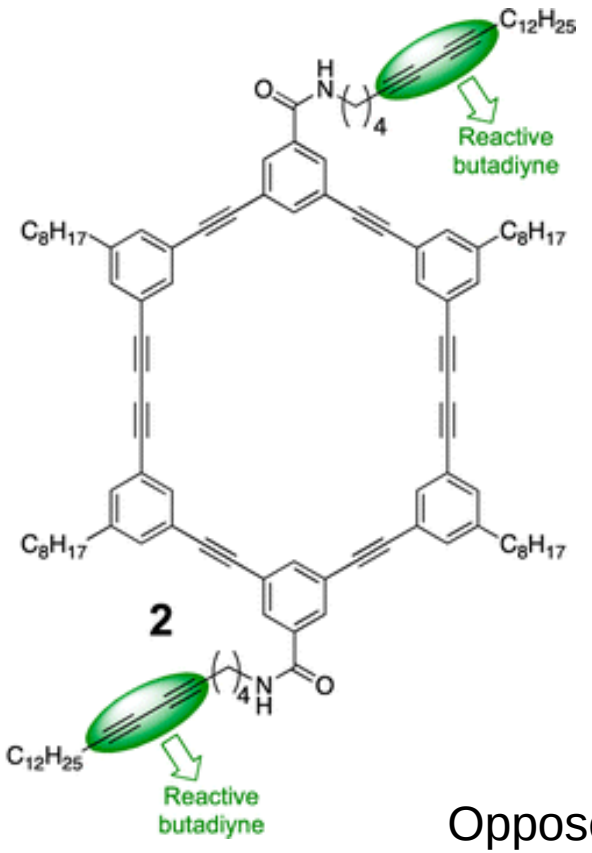


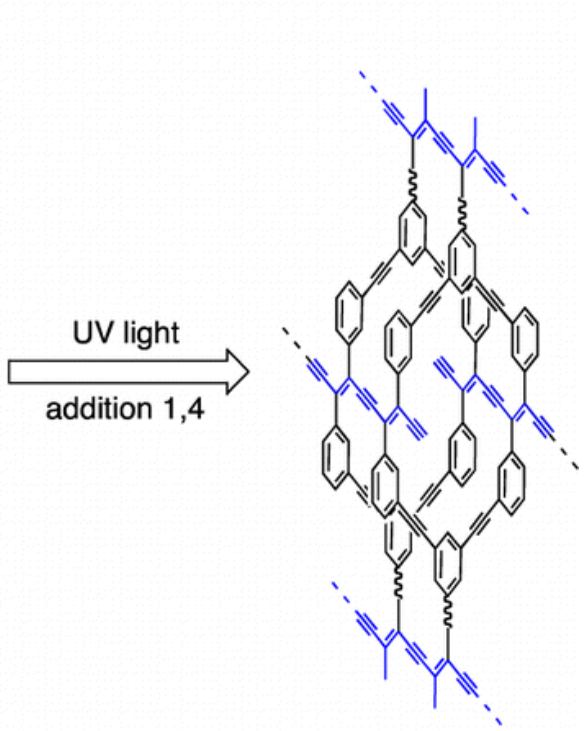
1 w/v% in decalin as a function of the temperature

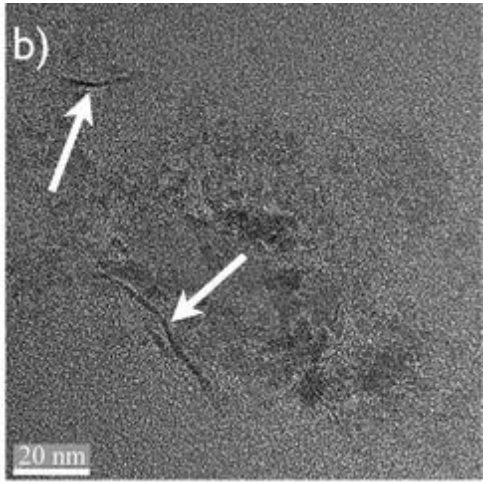
Topochemical Polymerization of PA Macrocycles

S. Rondeau-Gagné, J. Roméo Néabo, M. Desroches, J. Larouche, J. Brisson, J.-F. Morin; *J. Am. Chem. Soc.* **2013**, *135*, 110–113

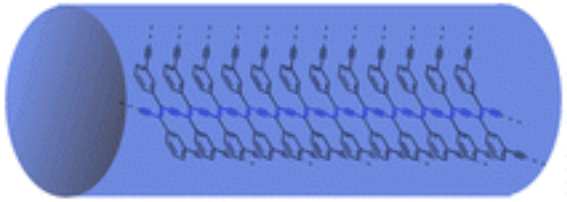








HRTEM image of nanorods



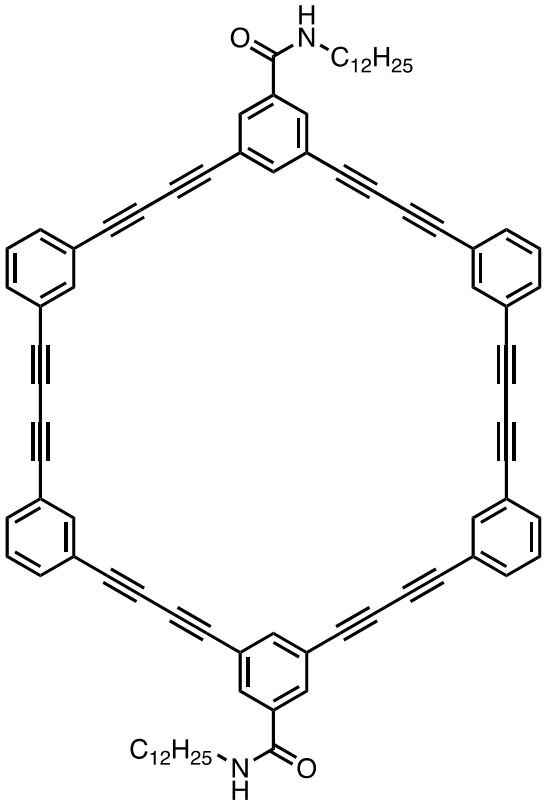
1D PDA nanowires

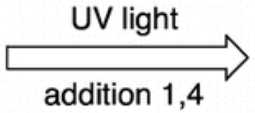
Opposed amide configuration:

S. Rondeau-Gagné, J. Néabo, M. Desroches, K. Cantin, A.Soldera, J.-F. Morin; *J. Mater. Chem. C* **2013**, *1* , 2680-2687

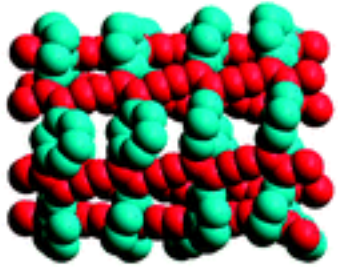
Topochemical Polymerization of PA Macrocycles II:

S. Rondeau-Gagné, J. Roméo Néabo, M. Desroches, I. Levesque, M. Daigle, K. Cantina, J.-F. Morin; *Chem. Commun.* **2013**, *49*, 9546–9548

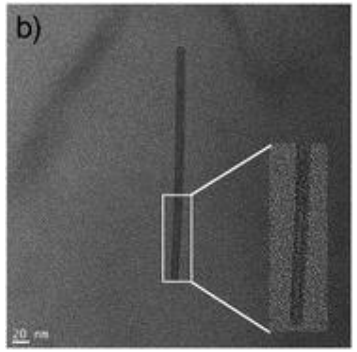




Nanotube **PDA1**
(front view)



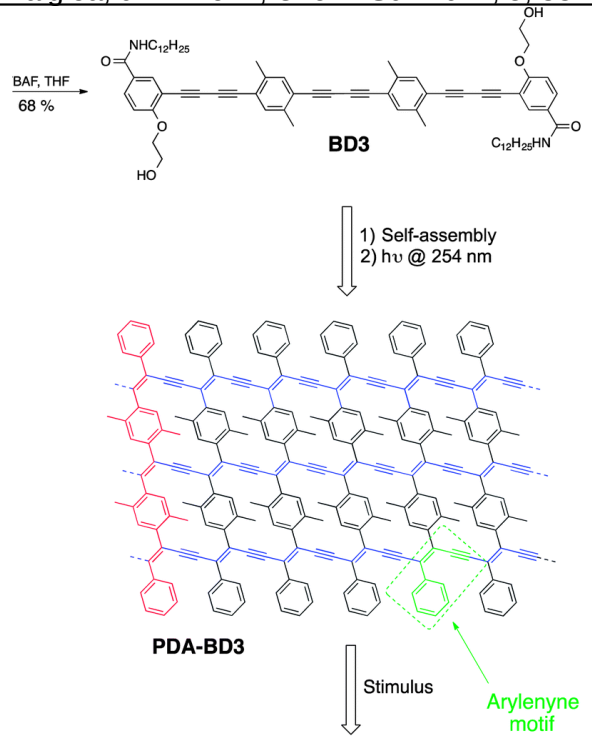
Nanotube **PDA1**
(side view)

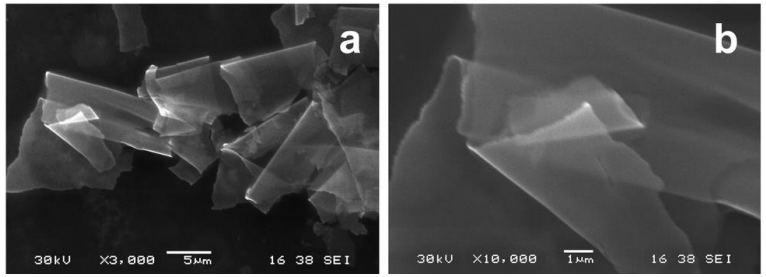


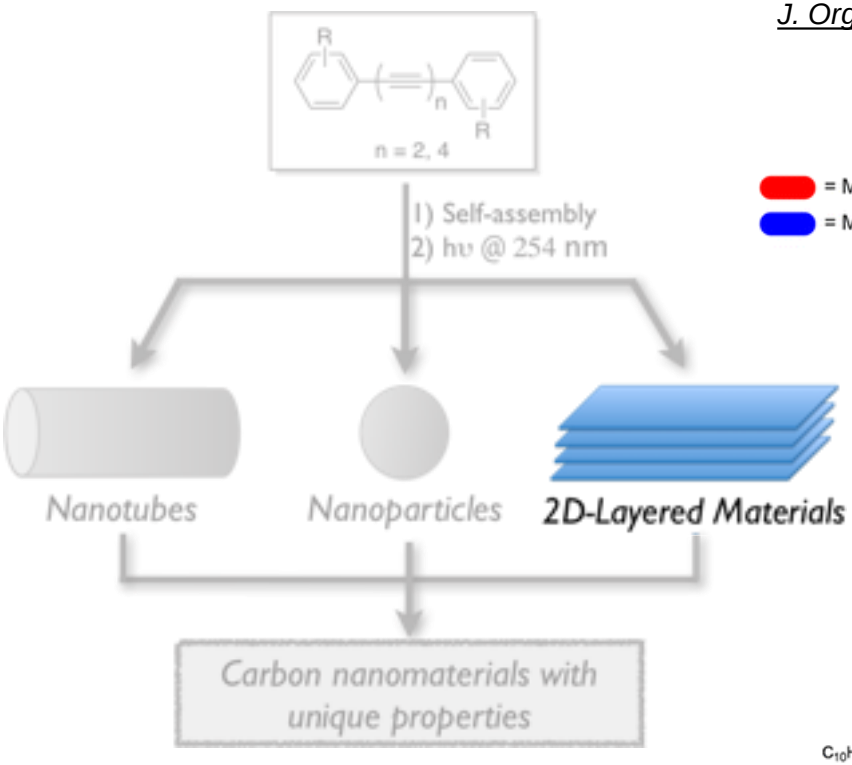
HRTEM image
of nanotube

Layered graphitic materials

I. Levesque, J. Roméo Néabo, S. Rondeau-Gagné, C. Vigier-Carrière, M. Daiglea, J.-F. Morin; *Chem. Sci.* **2014**, *5*, 831–836

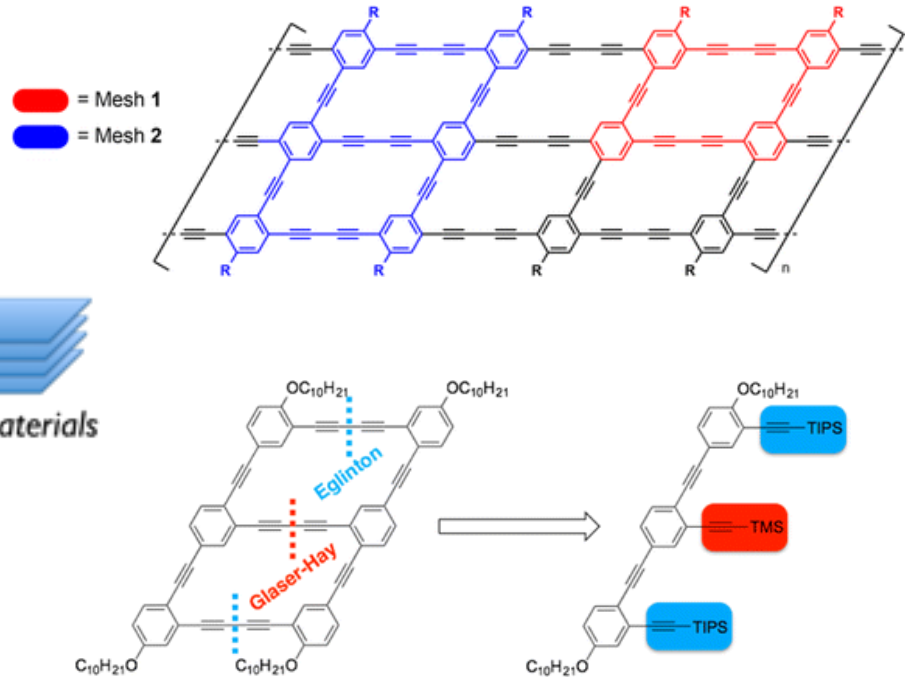






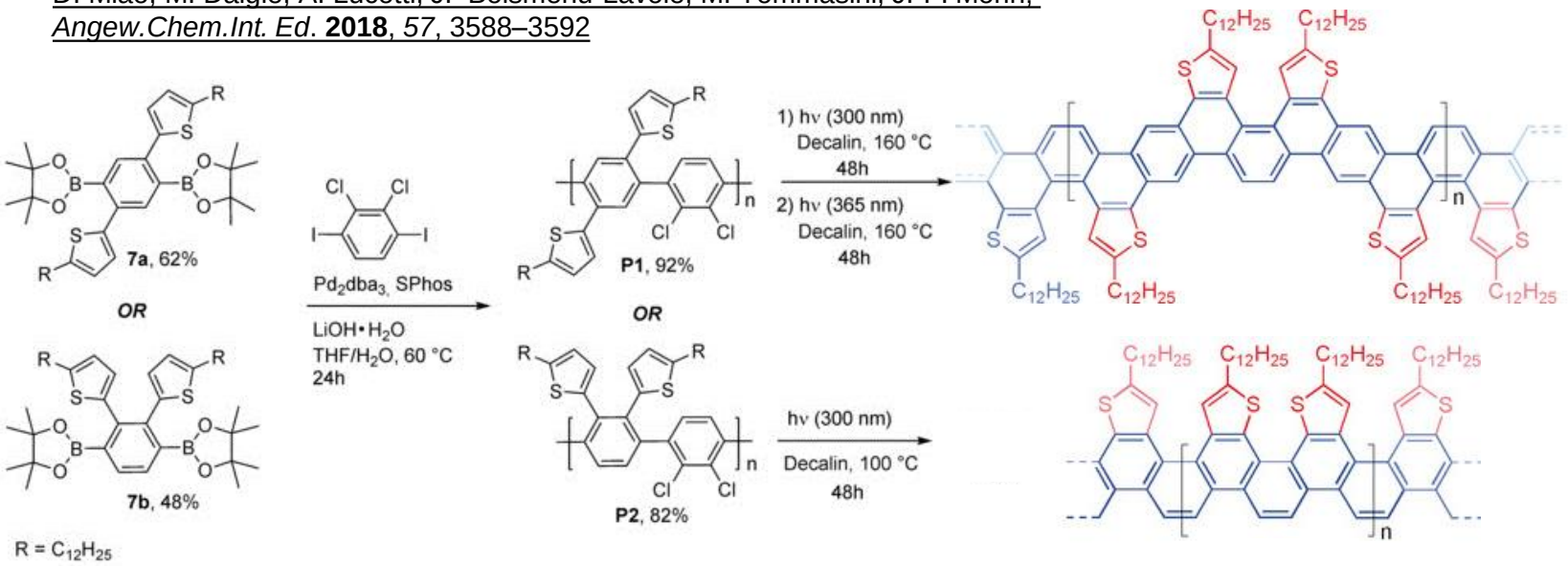
Subunits for nanoribbons

M. Desroches, M.-A. Courtemanche, G. Rioux, J.-F. Morin; *J. Org. Chem.* **2015**, *80, 10634–10642*



Thiophene-Annulated Graphene Nanoribbons:

D. Miao, M. Daigle, A. Lucotti, J. Boismenu-Lavoie, M. Tommasini, J.-F. Morin;
Angew.Chem.Int. Ed. **2018**, *57*, 3588–3592

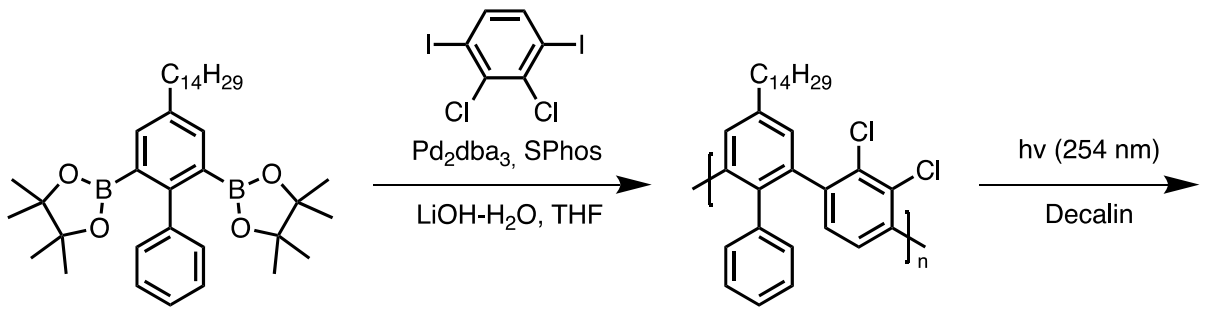


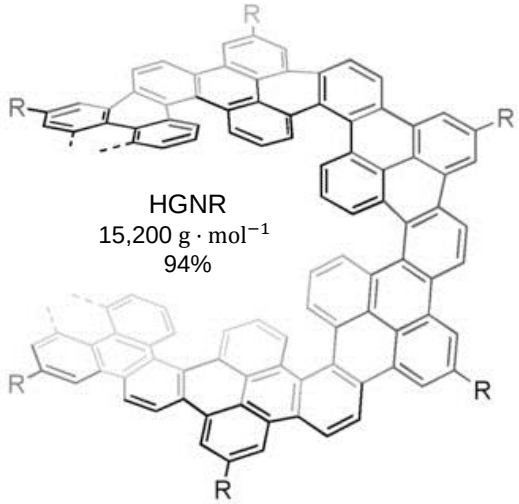
*p*T-GNR
20,800 g · mol^{-1}
96%

*o*T-GNR
27,700 g · mol^{-1}
92%

Helically Graphene Nanoribbons:

M. Daigle, D. Miao, A. Lucotti, M. Tommasini, J.-F. Morin;
Angew.Chem. Int.Ed. **2017**, *56*, 6213–6217





HGNR
15,200 g · mol^{-1}
94%

π-extended Ullazine derivatives

D. Miao, C. Aumaitre, J.-F. Morin;
J.Mater.Chem.C **2019**, *7*, 3015–3024