

A microfluidic strategy for the separation of enantiomers



Adeline Perro

Microfluidics for synthetic biology and health applications 2018

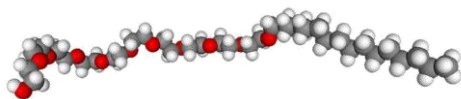
Chirality

- Enantiomeric compounds: same molecular formula and bond sequence so-called "mirror images"
- Two enantiomers exhibit different biological activity in human body
- Chiral synthesis
 - Enantioselective catalyst
 - Biocatalyst
- Chiral separation
 - High performance liquid chromatography (HPLC)
 - Gas chromatography (CE)
 - Capillary electrophoresis

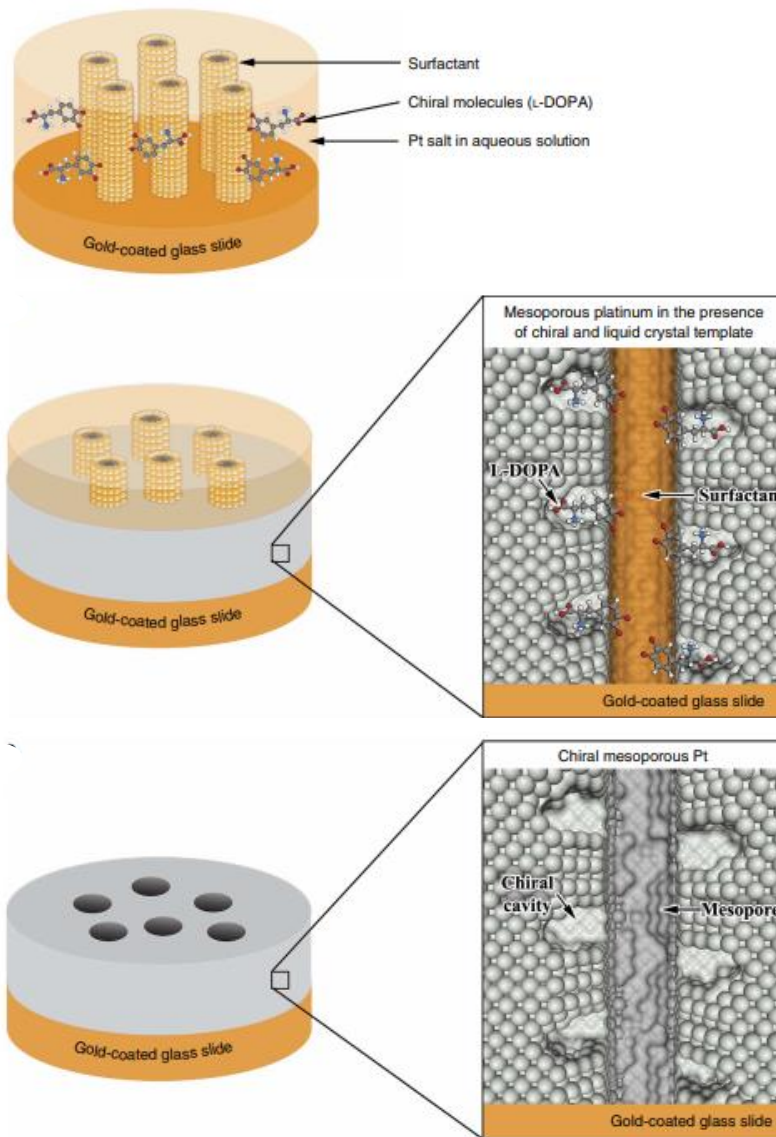
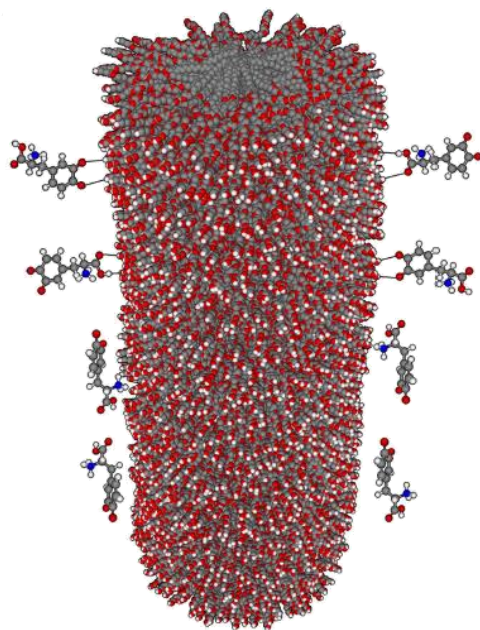
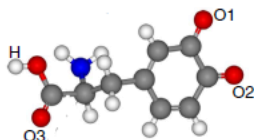


Enantioselective recognition at mesoporous chiral surfaces

Surfactant



Template molecule

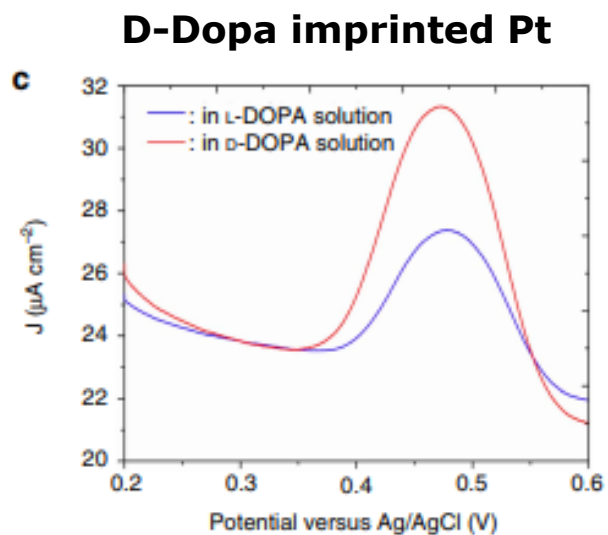
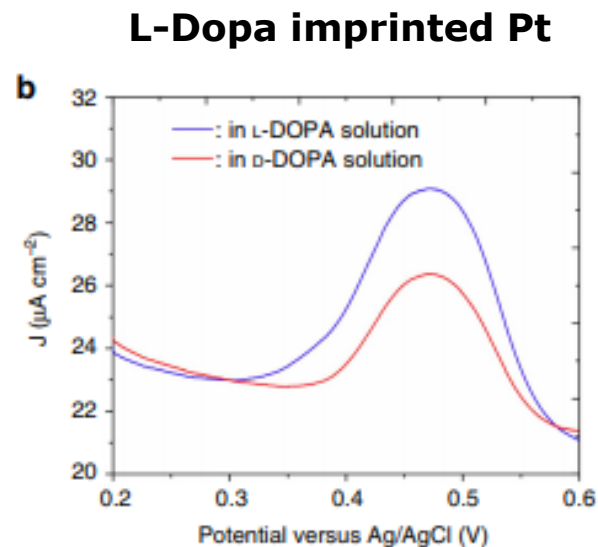
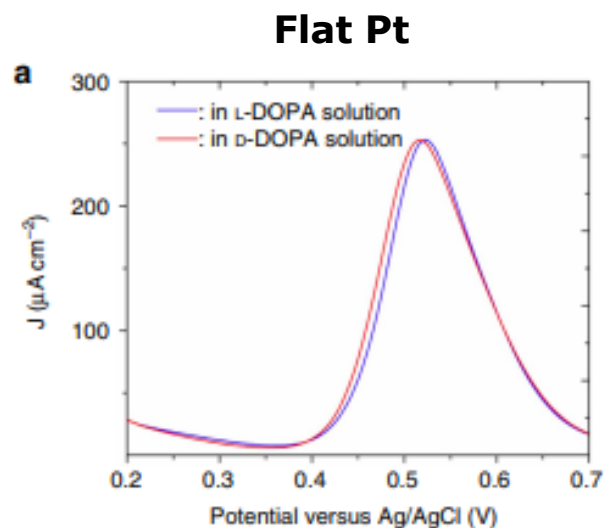


C. Wattanakit, T. Yutthalekha, S. Assavapanumat, V. Lapeyre and A. Kuhn, *Nat Commun*, **2017**, *8*, 2087.

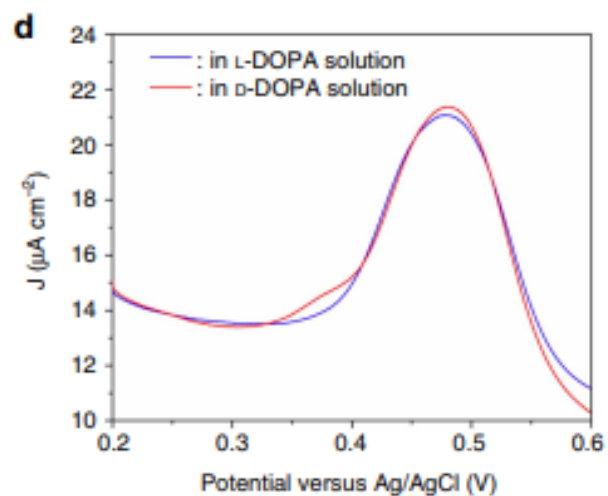
C. Wattanakit, Y. B. Come, V. Lapeyre, P. A. Bopp, M. Heim, S. Yadnum, S. Nokbin, C. Warakulwit, J. Limtrakul and A. Kuhn, *Nat Commun*, **2014**, *5*, 3325.

Enantioselective recognition at mesoporous chiral surfaces

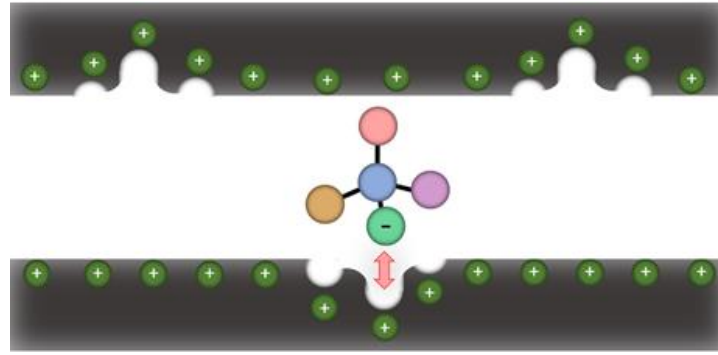
Differential pulse voltammetry of encoded electrodes in various solutions



After destroyed chiral structure

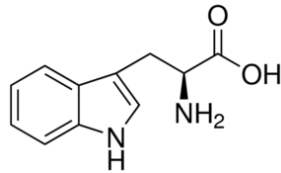


General concept



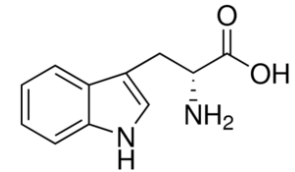
Tryptophan (Trp)

L-Trp



- Essential amino acid
- Protein synthesis in human body
- Precursor of neurotransmitter serotonin

D-Trp

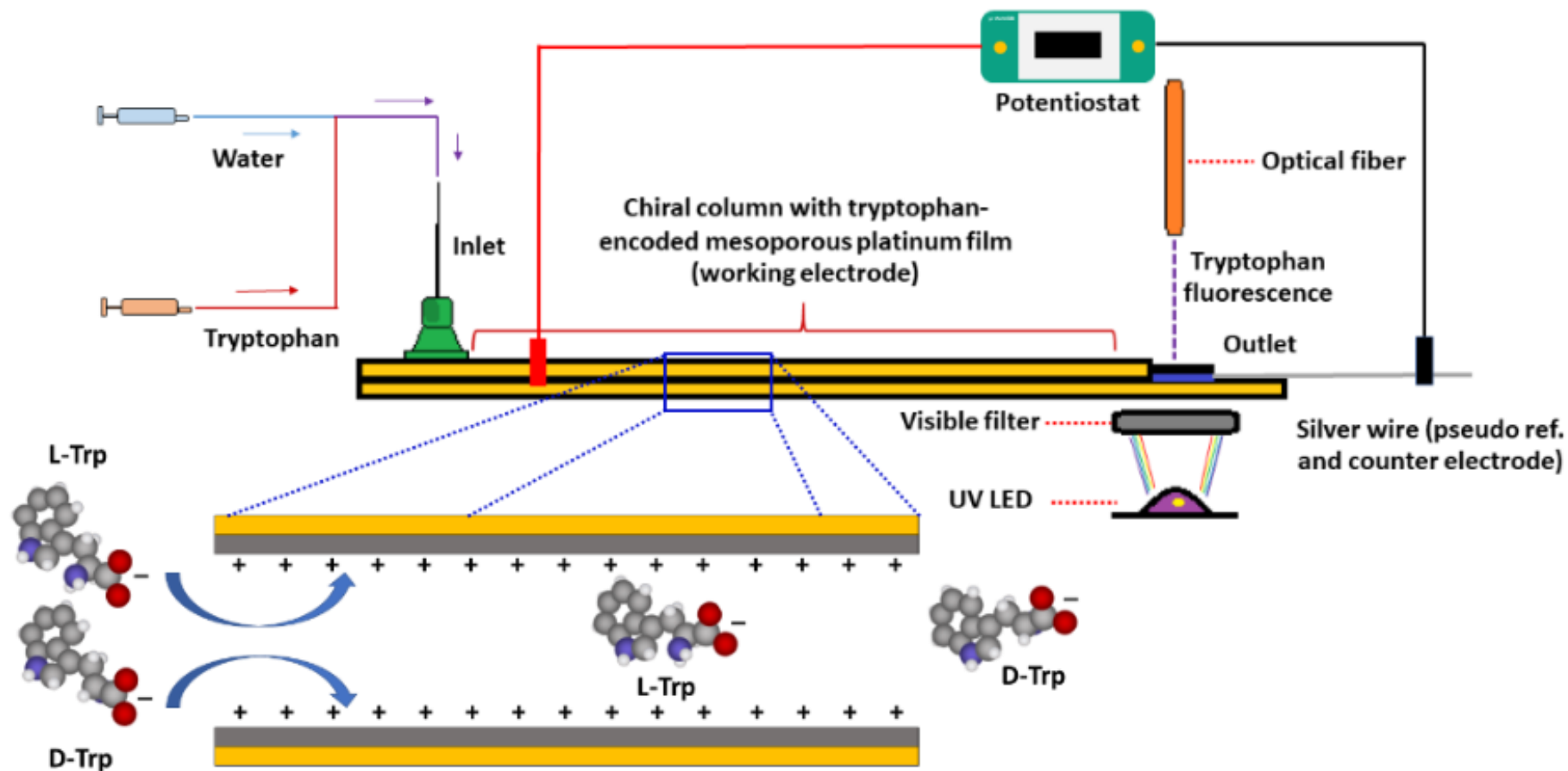


- Important Intermediate in the synthesis of peptide antibiotics

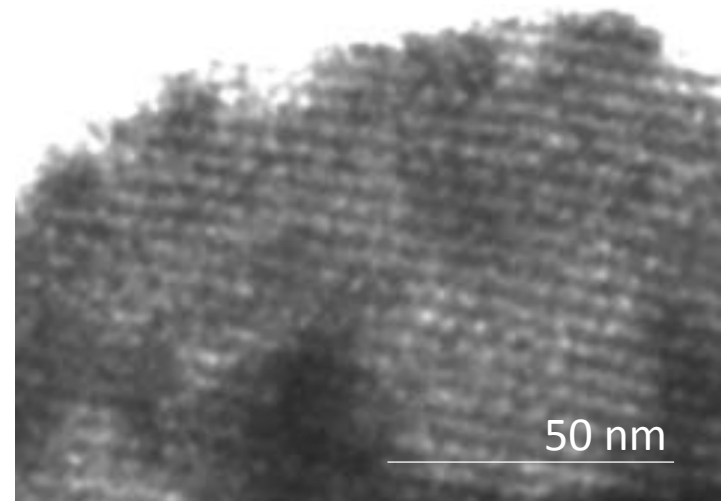
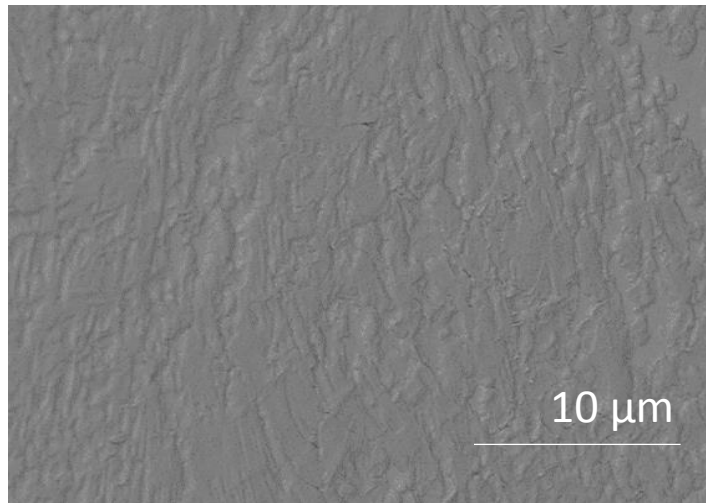
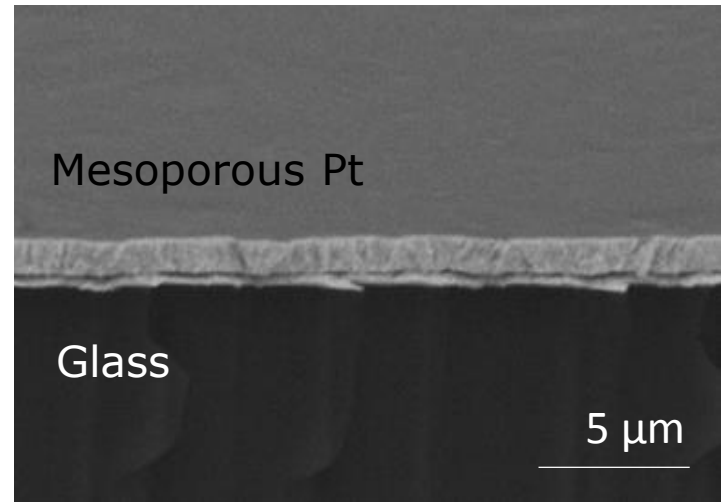
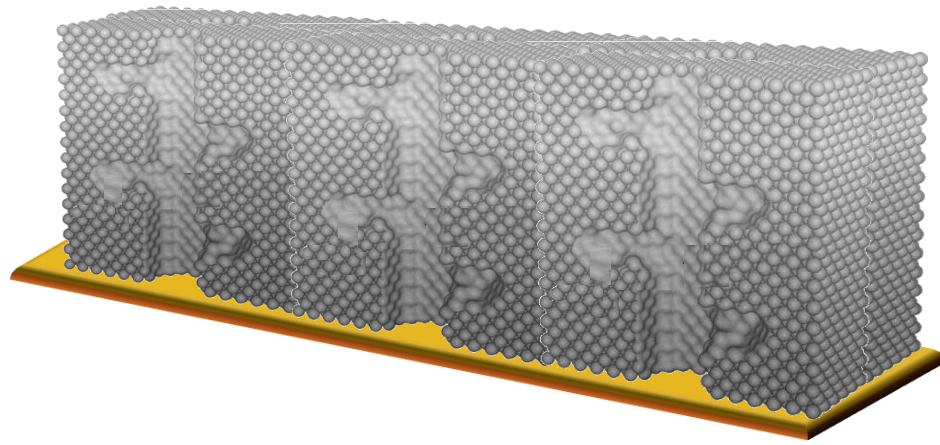
Build a microfluidic device in order to separate the enantiomers

Microfluidic device

Hyphenated microfluidic electrochromatography device with a L-Trp-encoded mesoporous platinum film as stationary phase.



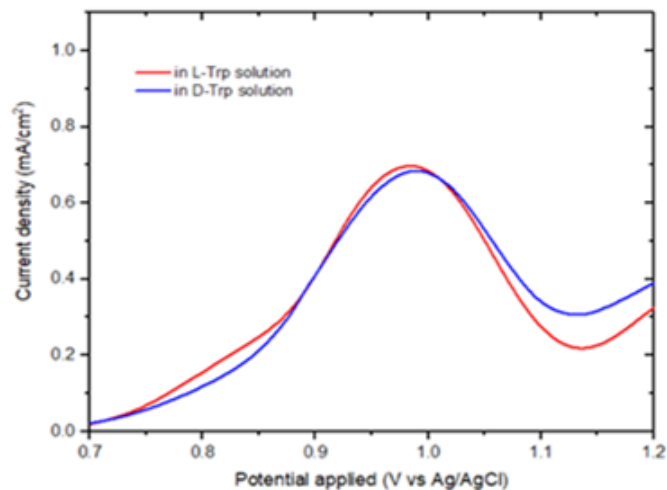
Chiral surface characterization



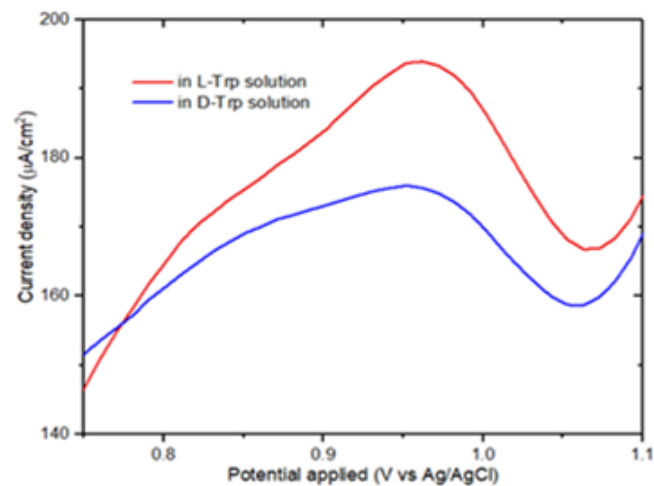
Chiral surface characterization

Different pulse voltammetry of encoded electrodes in various solutions

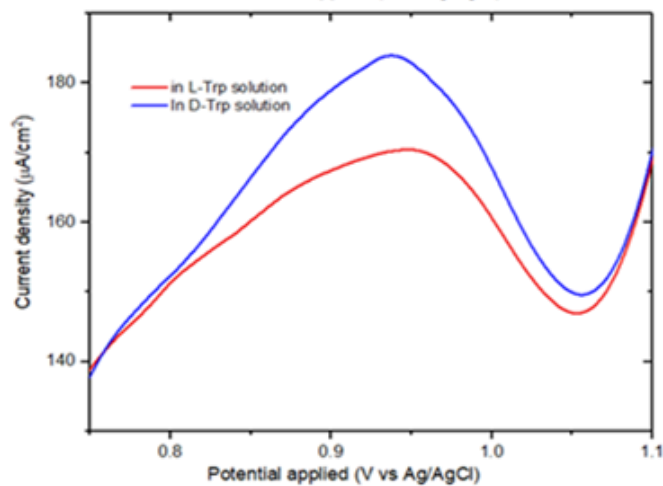
Flat Pt



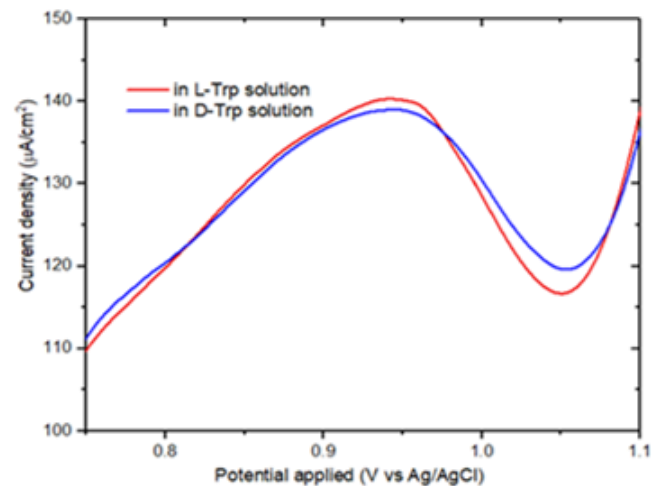
L-Trp imprinted Pt



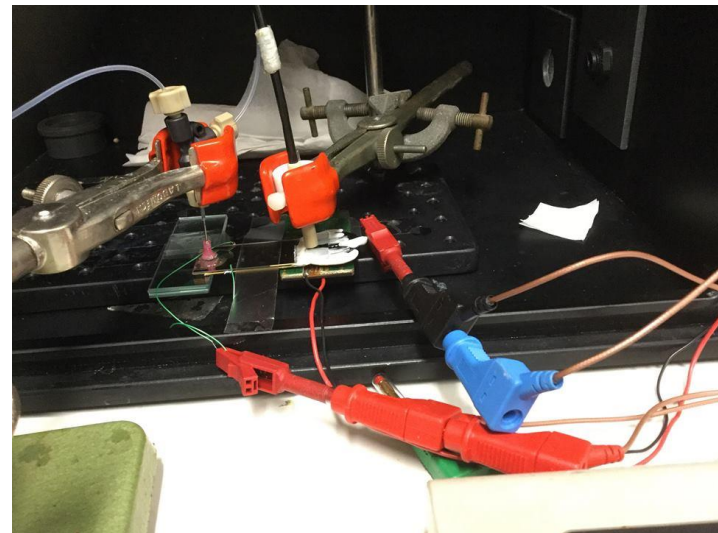
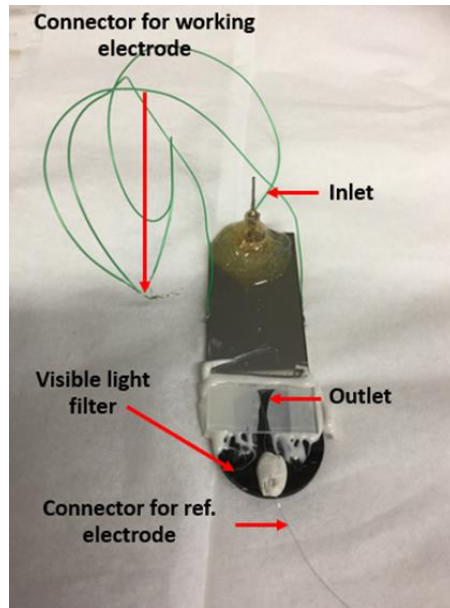
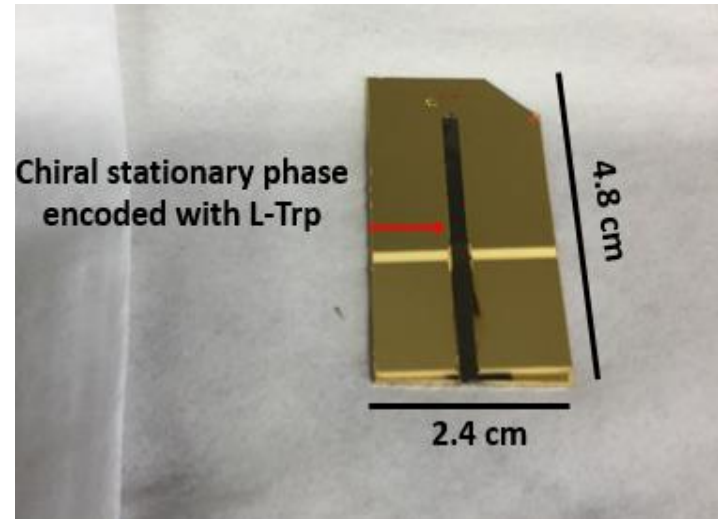
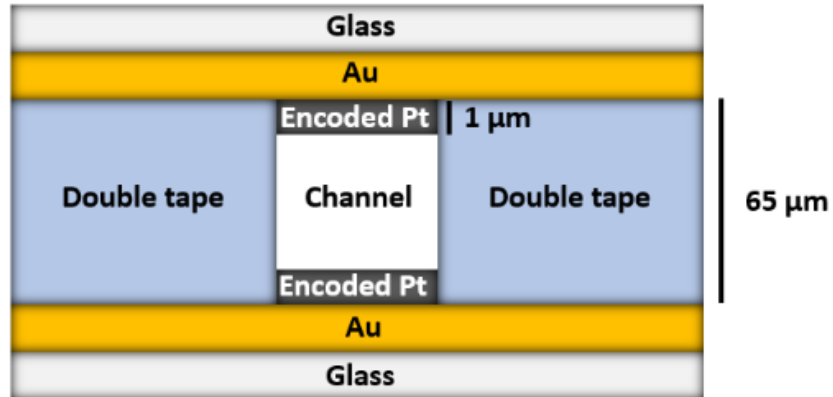
D-Trp imprinted Pt



After destroyed chiral structure

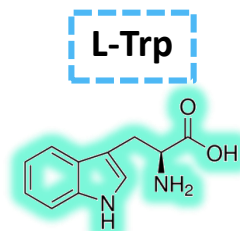
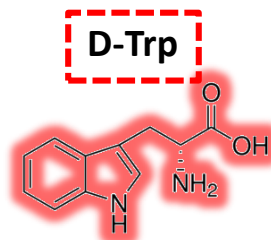
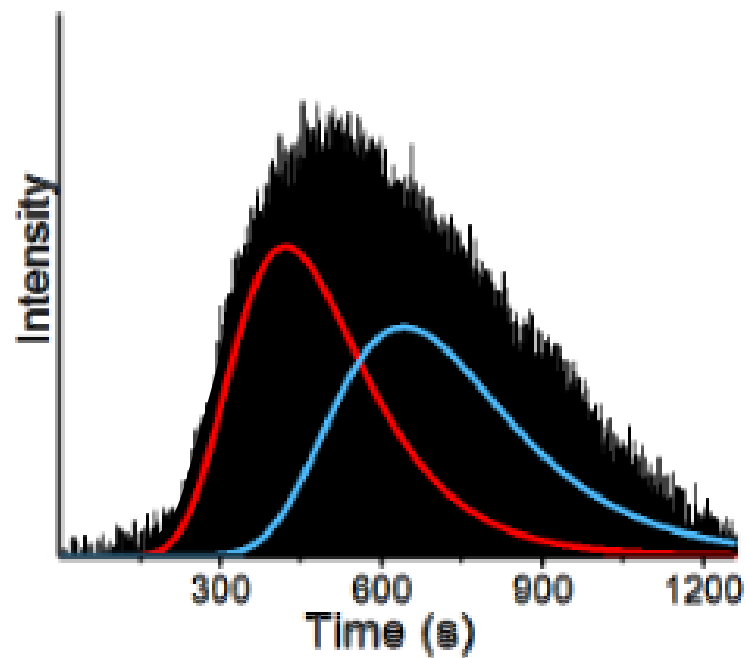


Microfluidic device



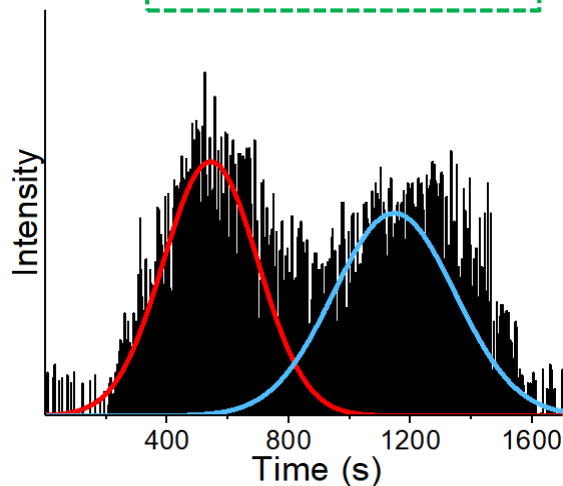
Racemic tryptophan discrimination

No applied potential

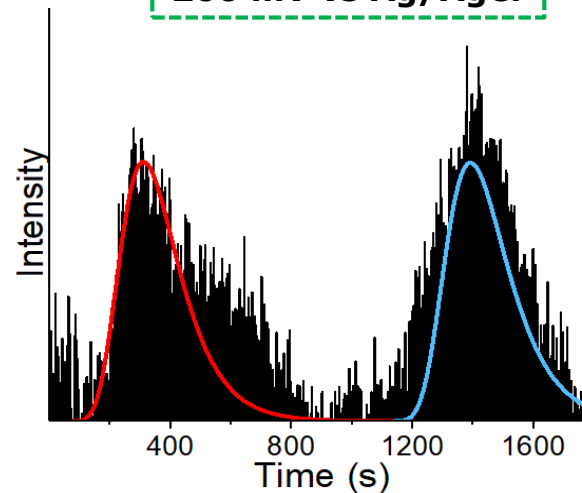


Racemic tryptophan discrimination with various potential applied

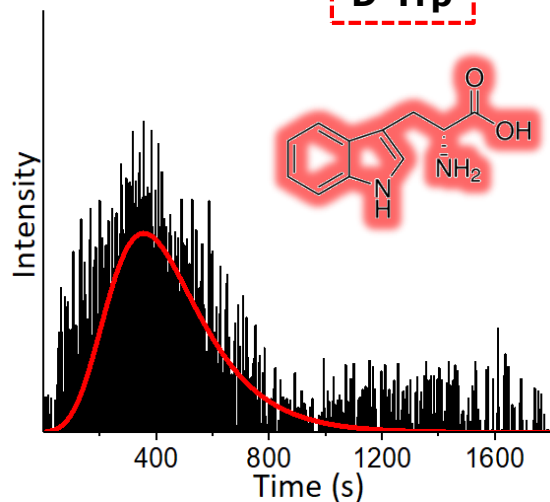
100 mV vs Ag/AgCl



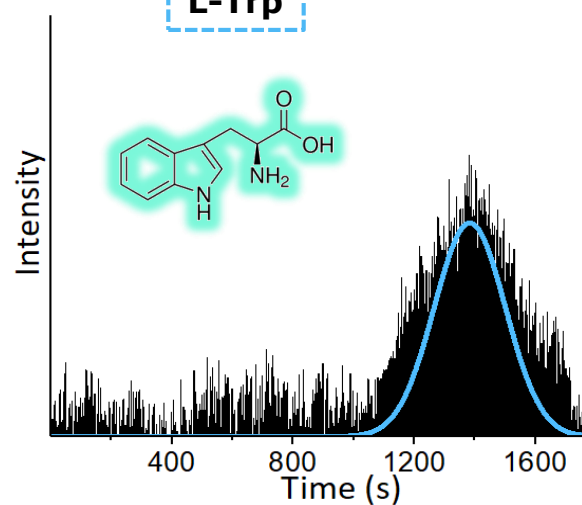
200 mV vs Ag/AgCl



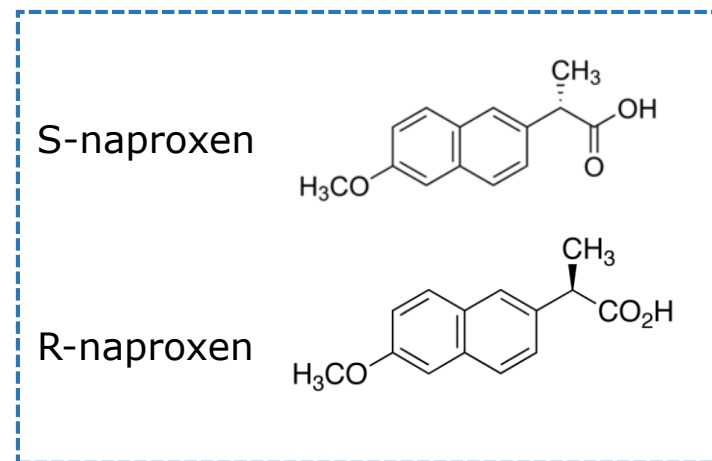
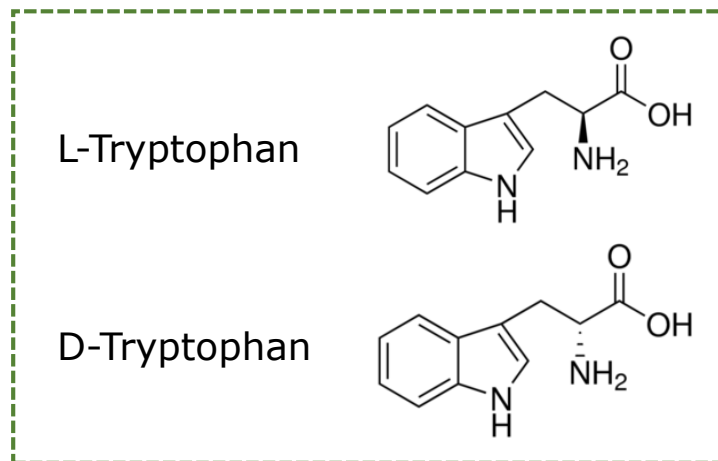
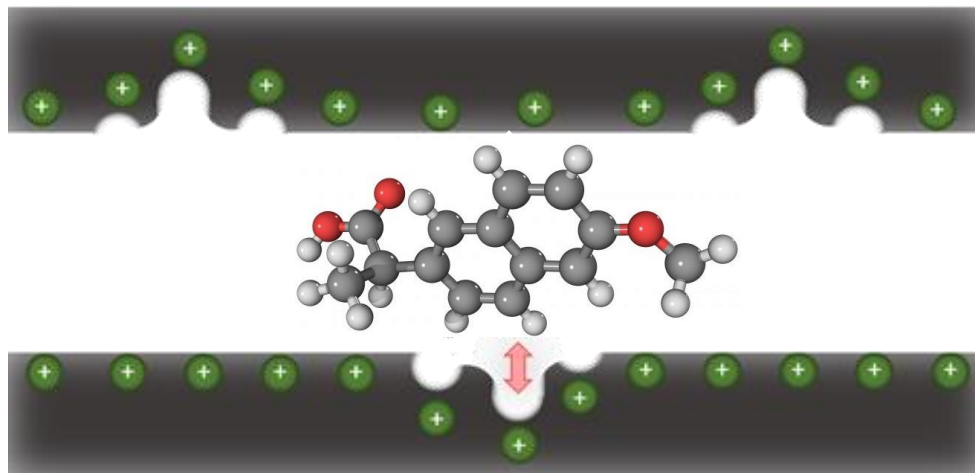
D-Trp



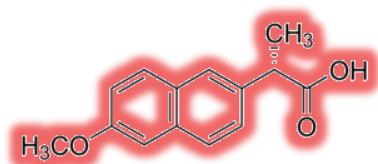
L-Trp



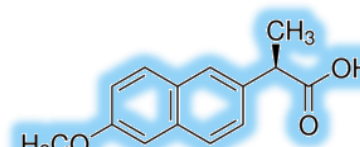
Racemic discrimination of other chiral molecules



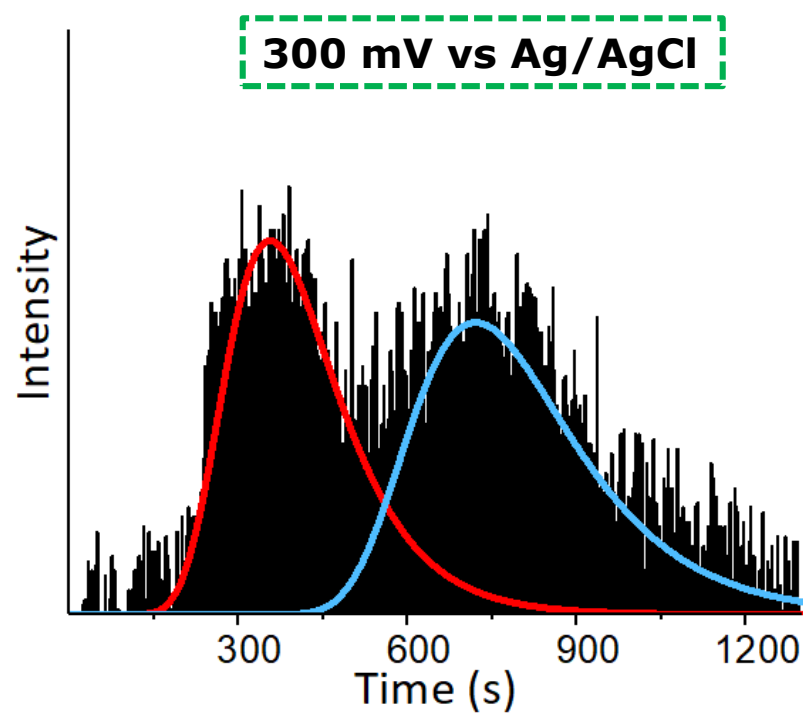
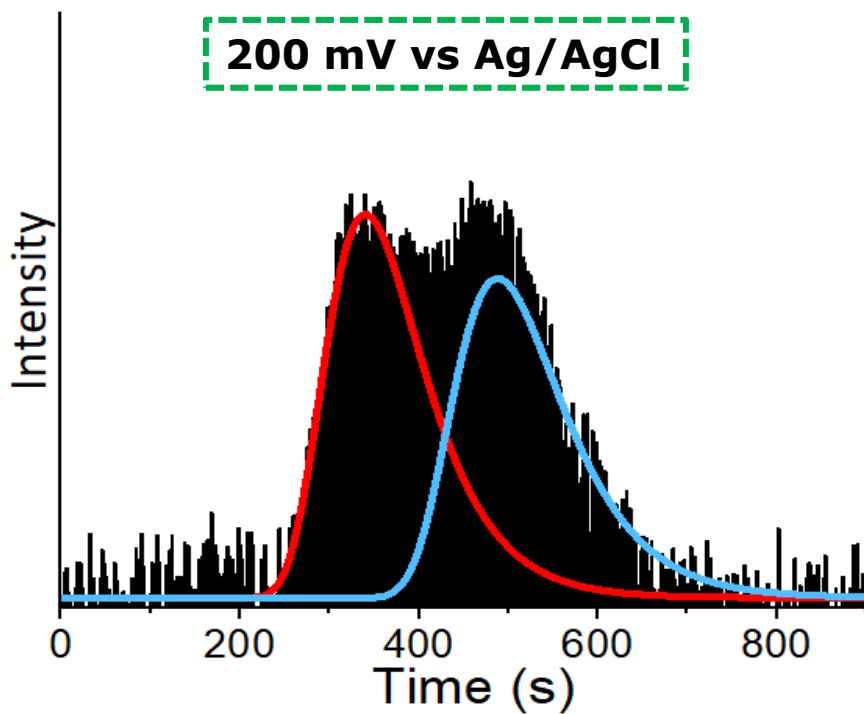
Racemic naproxen discrimination with various potential applied



S-naproxen



R-naproxen



Conclusion

Microfluidic device:

- Tryptophan imprinted mesoporous platinum
- In situ fluorescence characterization



→ Electroseparation of a racemic solution of tryptophan and naproxen





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