PolymerBioPath
Bio-inspired catalytic platforms as a sustainable route to Polymers
CP2D 2007

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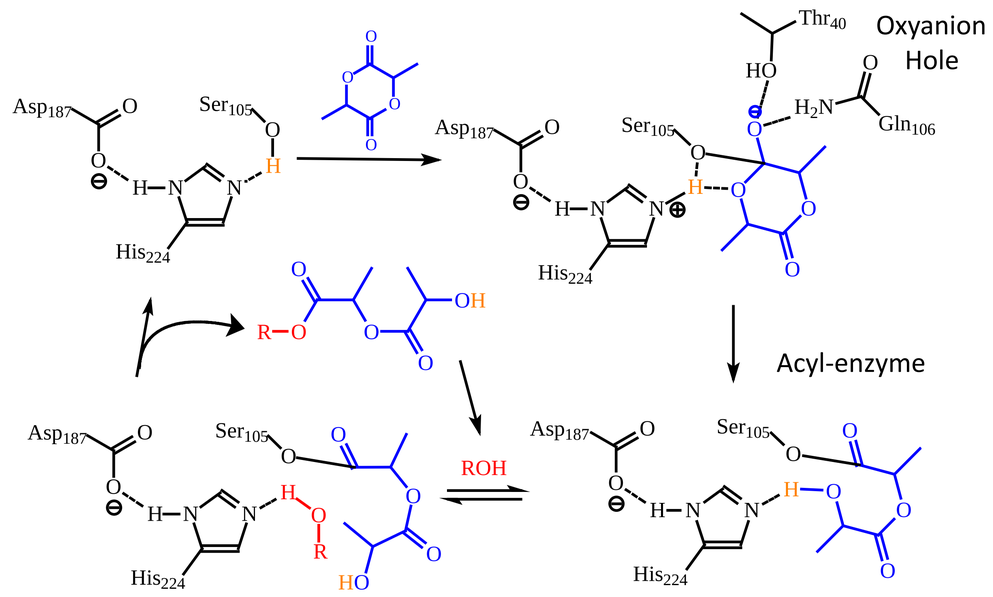
Objectives of the project

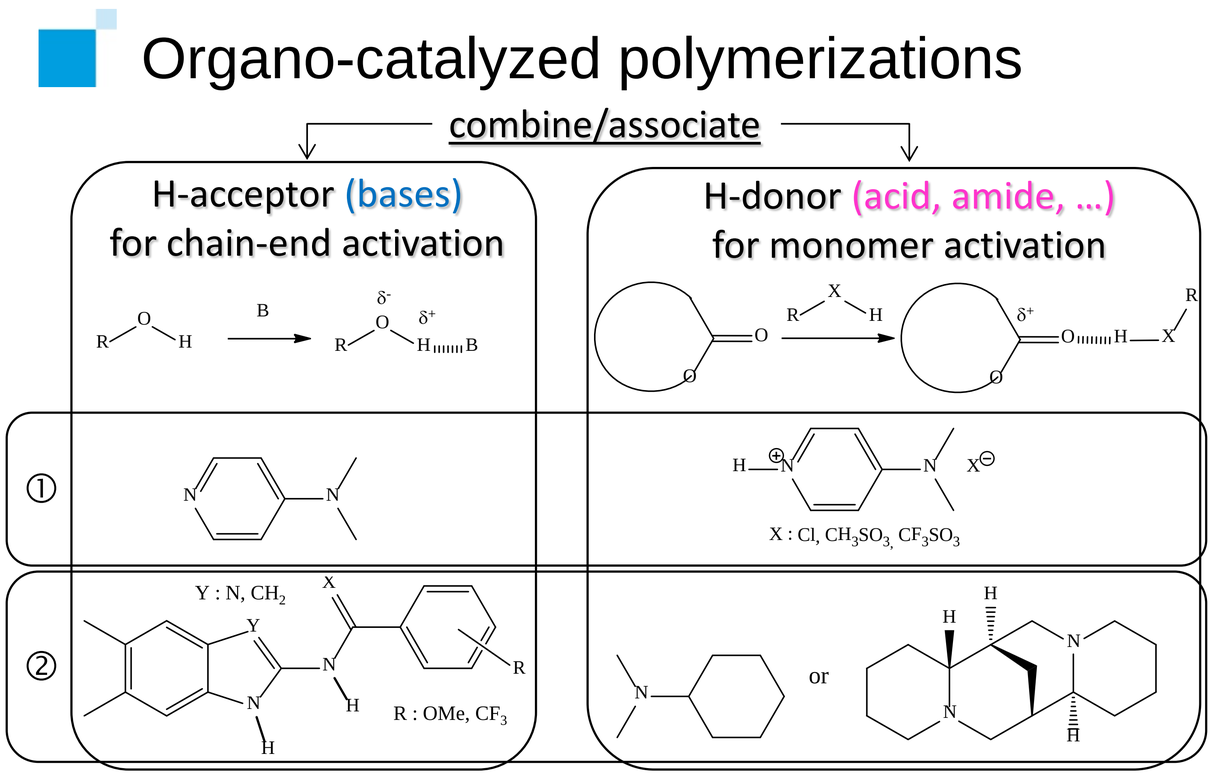
Today, most of the polymers contain toxic metal residues (transition metals, Al., Cr., Sn., etc). Despite their low concentration, these latter are suspected to generate environmental and health problems, still not completely identified and quantified. Metal residues also limit the use of some polymers in important domains (biomaterials, pharmaceutical, electronics, food packaging).
Our main objectives were thus :

- The study of the Ring-Opening Polymerization (ROP) of lactide and lactones via metal-free catalyses
- The development of new bio-inspired synthetic routes thanks to organic catalytic platforms developping H-bonding interactions like lipases do (Scheme below)
- The study of ROP catalyzed by modified enzymes



ROP of lactide catalyzed by Candida Antarctica Lipase B (CALB)

Organo-catalyzed polymerizations



Catalytic system ①

- Polymerization rate highly dependent on X^-
- Living/controlled ROP of lactide in dichloromethane at RT or in bulk at 100° C
- Living/controlled ROP of lactones in bulk at 100° C
- Synthesis of block copolymers

Catalytic system ②

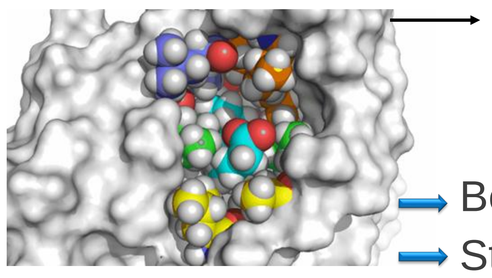
- Polymerization rate dependent on Y, R and tertiary amine
- Living/controlled ROP of lactide in CH_2Cl_2 at RT with high rate

Enzymatic polymerizations

Lipases = hydrolases <u>BUT</u> can perform polymerization of D-LA, lactones, carbonates, … and polycondensation in non-aqueous media

☺ easily accessible
robust (solvent, T)

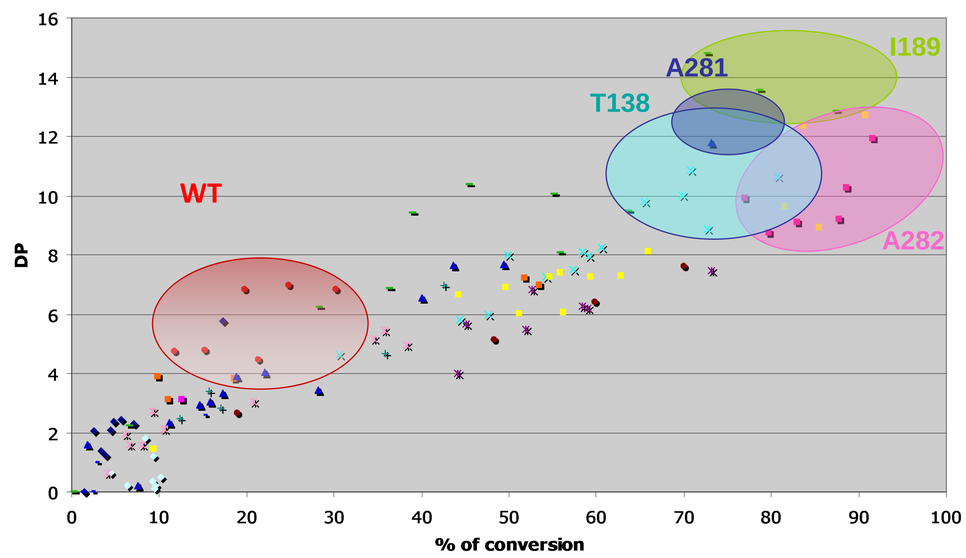
☹ high loading
slow rate



→ Modification of reactive pocket by mutagenesis
→ Mono-mutants
→ Better catalyst for polymerization
→ Stereospecificity

- Improvement of polymerization rate
- Selectivity in hydrolysis reactions

ε-CL, 15h, 60°C, toluène



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