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Education and Positions

Engineer (chemistry) Conservatoire National des Arts et Métiers 1979 Paris
 Master Degree (DEA) "Spectrochemistry " 1979 - Paris VI University
 PhD (thèse d'état) : "Nouveaux réactifs de chloration régiosélective"(new regioselective chlorinating reagents) 1980 –Paris VI University - (Director professor J.P. Guetté)
 Postdoctoral fellow: 1981-1982 Groningen University (Netherlands) Pr. R.M. Kellogg
 - Assistant Professor CNAM (Paris) 1981-1989.
 - Professor 2nd class (1989), 1st class (1994) Exceptionnal class(2001), University Lyon 1.

Achievements and Awards

- Author of 292 articles and inventor of 54 original patents (most of them are international)
 - H factor 41 (Web of Science the 1/12/09)
 - Langevin Award , French Academy of Science 1999
 - Berthelot Medal 1999
 - Innovation Award Rhône-Alpes 2000
 - "Guest Editor" (with P. Mangeney) of the 15th volume of "Topics in Organometallic Chemistry 2005"
 - Grand prix « Lebel » SFC 2007 (with Dr B. Meunier)

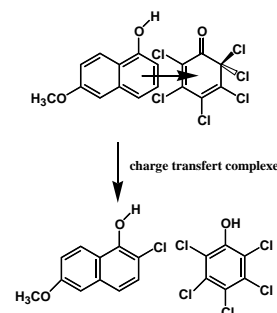
Bibliometry of the most cited articles web of science the 12/1/09

Chemical Reviews 102 (5), 1359-1469, 2002	1096	Tetrahedron Lett. 39 (17), 2559-2560, 1998	57
Chemical Reviews 100 (6), 2159-2231, 2000	496	J. Electroanalytical Chemistry 281 (1-2), 293-298, 1990	51
J. Physical Chemistry 91 (27), 6706-6714, 1987	259	Tetrahedron Lett. 38 (13), 2275-2278, 1997	53
Synt. Metals 15 (4) 323-33, 1986	179	J. Chem. Soc. Chem. Comm. (5), 414-416, 1990	50
Tetrahedron Asymmetry, 6 (3), 705-718, 1995	126	Synt. Metals 28 (1-2), C341-C348, 1989	52
J. Catal. 191 (2), 409-422, 2000	139	Applied catalysis A-General, 131 (1), 143-157, 1995	49
Chemical Reviews 102 (10), 3467-3493, 2002	149	Tetrahedron Lett. 41 (33), 6347-6350, 2000	52
J. Chem. Soc. Chem. Commun. (10), 658-661, 1988	123	J. Chem. Soc. Chem. Commun. (19), 1500-1502, 1987	50
J. Catalysis 170 (1), 29-36, 1997	103	J. Organomet. Chem. 603 (1), 30-39, 2000	46
Tetrahedron 54 (45), 13793-13804, 1998	101	Tetrahedron Lett. 38 (51), 8867-8870, 1997	50
Tetrahedron Lett 34 (43), 6897-6898, 1993	87	Applied Catalysis A- General 231 (1-2), 253-261, 2002	45
J. Chem. Soc. Chem. Commun.(11), 679-681, 1989	81	Synt. Metals 36 (2), 267-273, 1990	45
Catalysis Today 84, (3-4), 129-138, 2003	101	J. Org chem. 51 (26), 5169-5177, 1986	45
Macromolécules 23 (5), 1347-1352, 1990	77	Tetrahedron Asymmetry 6 (5), 1109-1116, 1995	44
Chemical Reviews 105 (5), 1801-1836, 2005	89	J. Chem. Soc. Chem. Commun. (8), 475-477, 1989	44
J. Chem. Soc. Chem. Comm. (12), 1417-1418, 1994	70	Tetrahedron Asymmetry 9 (6), 897-900, 1998	43
Advanced Synthesis 344 (9), 915-928, 2002	73	J. Electroanalytical Chem. 277, (1-2), 355-358, 1990	43
J. American. Chem. Soc. 120 (7), 1441-1446, 1998	60	Tetrahedron 57 (37), 7845-7855, 2001	50
Synt. Metals 18, (1-3), 139-144, 1987	59	J. Catalysis 193 (2), 255-263, 2000	49
Organic Lett. 3 (16), 2493-2496, 2001	61	J. Electroanalytical Chem. 278 (1-2), 373-378, 1990	50
New J. Chemistry 13 (12), 863-871, 1989	57	J. Org Chem 51 , 26, 5169-5177 1986	44

A large part of the research in the Lemaire's group is performed in the frame of cooperation with industrial partners and special grants; for the last twenty years: **CEA, COGEMA, FRAMATOME, CEZUS, National Starch, Rhône-Poulenc, Rhodia, Biomérieux, Total, IFP, Elf, Chiralsep, Futurase, Dupont Coating, Von Roll, Charabot, Synt.:Em, Solvay, PPD, NIPPON Oil, Apibio, Merial, Minakem, ONIDOL, Sofiproteol, Novance, several government organisms ADEME, ANVAR, ANR, FUI and European funding.**

Past Research Areas

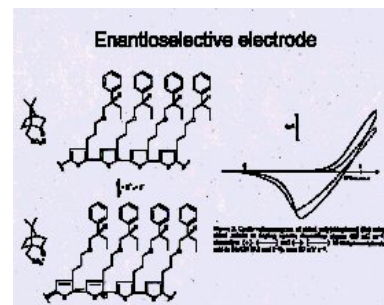
During my PhD under the supervision of Professor J. P. Guetté, I described the use of O and P hexachlorocyclohexadienones as chlorinating agents. These new chlorinating reagents are able to deliver the chlorine atom either on ortho or on para position of substituted aromatic rings, thanks to the formation of Charge transfer interaction between substrate and reagent. These reagents are now commercialized by Acros Chemicals and Aldrich, and are named as « *Guy, Lemaire, Guetté Reagents* » in Organic Synthesis Based on Name Reactions A. Hassner and C. Stumer editor Pergamon, 2002 p.142.



exemple de reactif selectifs grace à des interactions à transfert de charge

During my post-doctoral position I worked on the asymmetric version of the Kumada-Corriu reaction. We were the first group to describe the use of chiral thiomacrocycles as ligands for metal catalyse asymmetric C-C bond formation in 1981.

As Assistant Professor in CNAM, I worked on new regioselective reagents (oxidation, nitration..) using charge transfer interactions with Professor J.P. Guetté. I also developed cooperation with Drs F. Garnier and J. Roncali in the field of organic conductor. In this particular area, I was the first to show the enantioselective recognition of chiral anions by chiral polythiophen during the cyclic voltametry. This article was cited in the « highlight » of « *Chemistry Industry* » july 18th 1988, p. 470.



Present research areas

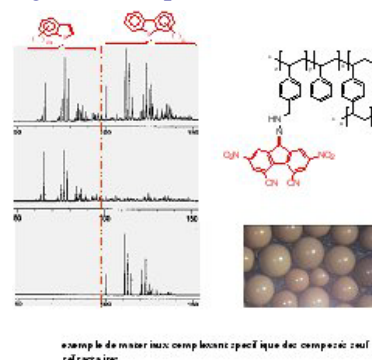
Our "Catalysis and Organic Synthesis" CASO group work currently in three main areas: Separation Science and Technology, Catalysis and Sustainable Chemistry and Synthesis of Biologically Active Molecules. These three domains are connected because the new technologies and the new catalysts developed in the two first areas are used in the synthesis of complexe molecules in the third.

1°Separation Science and technology

Separation and purification are time consuming and have often high ecological and economical impacts. Nevertheless only few academic laboratories are working in this field. Distillation and crystallization are the most preferred purification methods in industry but liquid liquid extraction, specific resins and filtration technologies are now fast developing. We have worked in these three areas by designing and synthesis of new extarctants, new materials and new complexing agents.

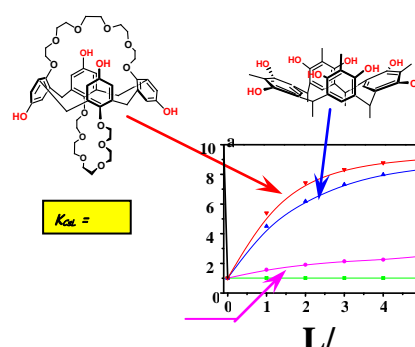
In the case of liquid/liquid extraction, we designed and synthesized ligands for specific extraction of alkaline, lanthanide or actinide cations. For example, we were able to extract selectively the plutonium nitrate from highly concentrated and radioactive solutions using cis syn cis isomer of Dicyclohexyl 18 crown 6. This result was selected as “important” in the review: *Chemie In Unserer Zeit* January 25th1991, 236.

For the separation using solid liquid processes we designed new specific resins for the separation of enantiomers, of ions and/or traces of pollutants. For example, in cooperation with petroleum companies we prepared polymer beads able to eliminate the sulfur containing molecules difficult to transform using hydrodesulfuration. The selective elimination of the so called “hard sulfur”, allowed us to perform the deep hydrodesulfuration of gasoil in very smooth conditions.



Nanofiltration is a very recent technology (less than 20 years) and we were among the first groups to associate this technology to a preliminary complexation step in order to obtain separation of ions having same charges and similar chemical properties. Separation of lanthanide and actinide as well as alkaline ions were obtained by this technology.

For example we were able to eliminate traces of cesium (10 mg L⁻¹) from highly concentrated solution of sodium nitrate (300 g L⁻¹).



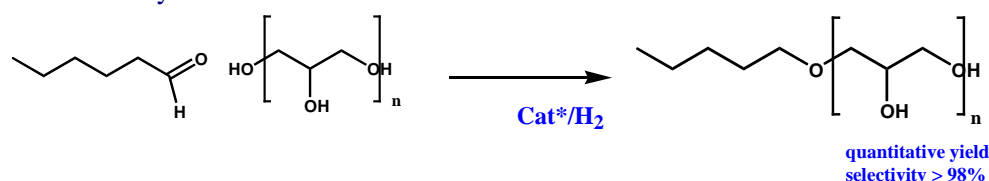
2° New synthetic methodology, sustainable chemistry

The last few years, many important efforts were realized in order to obtain sustainable chemical transformations. These research areas were widely studied in industrial laboratories but appear much more recently in academic laboratories. The concepts associated with this domain constitute the principles of green chemistry and green chemical engineering.

2.1 Catalysis and fine chemistry».

Catalysis is one of the most powerful tools to obtain chemical transformations with low ecological impact. In order to obtain alkylation of amides and alcohols without coproduction of salts, we have developed N and O reductive alkylation reaction as an alternative for the Williamson synthesis of ethers. These methods were cited as examples of green chemistry in the "Heart Cuts" of *Chem. Tech.* January 1995 and December 1995 as well in the "highlight" of *Chemistry and Industry* January 1997.112.

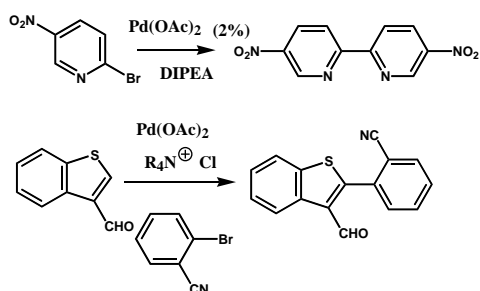
More recently we have applied this methodology for the synthesis of non ionic surfactant with high yield and selectivity.



Example of reductive alkylation of glycerol

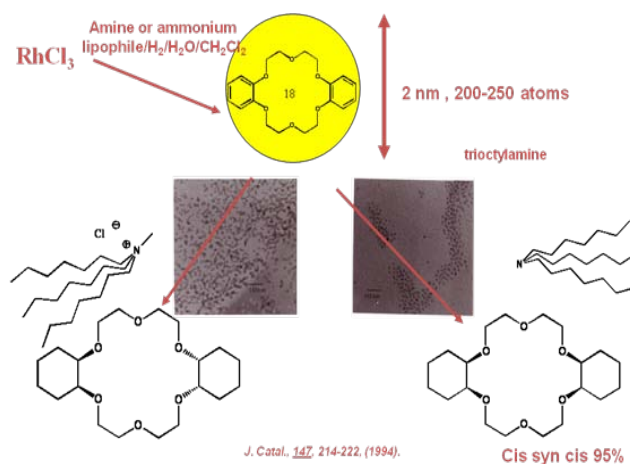
Aryl Aryl C-C bond formation is an important transformation in all areas of organic synthesis we have discovered a catalytic alternative for the Ullmann reaction and extended the Heck reaction to

thiophen and benzothiophen substrates. This last method is an efficient CH activation and was applied on various substrates for the synthesis of bioactive molecules (vide infra). The review we published concerning aryl-aryl bond formation in 2002 is cited more than 1100 times.



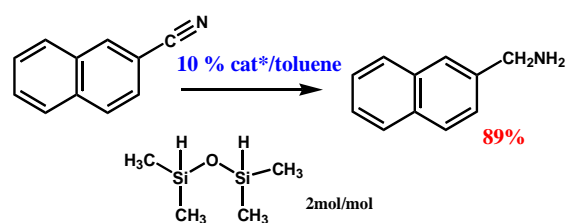
example of new method of formation of aryl aryl bonds

We were one of the first groups to use metal nanoparticles such as rhodium or ruthenium, prepared by reduction in the presence of cationic surfactants for the stereoselective reduction of aromatic rings. This methodology was used for the stereoselective synthesis of cis syn cis and cis anti cis isomers of macrocycle DCH 18C6.

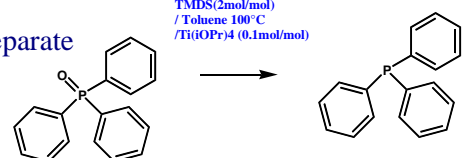


Example of stereoselective reduction of aromatic ring

The chemical and pharmaceutical industry use aluminum and borohydride in large scale; more than thousand tons a year, nevertheless these reagents are dangerous. They generally require the use of inflammable and water soluble solvents. Moreover, the work up is difficult and induces expansive waste treatment. The last few years we proposed to use tetramethyl disiloxane as reducing agent in the presence of various metal catalysts. This reagent is easy to handle and could be used in non water miscible solvent of low toxicity such as methyl cyclohexane. TMDS is a by product of silicon industry and the by-product of the reduction reaction by TMDS is a poly(siloxane) which is easy to separate and could be recycle as material.



example of reduction of nitrile
TMDS(2mol/mol)
/ Toluene 100°C
/Ti(OiPr)4 (0.1mol/mol)



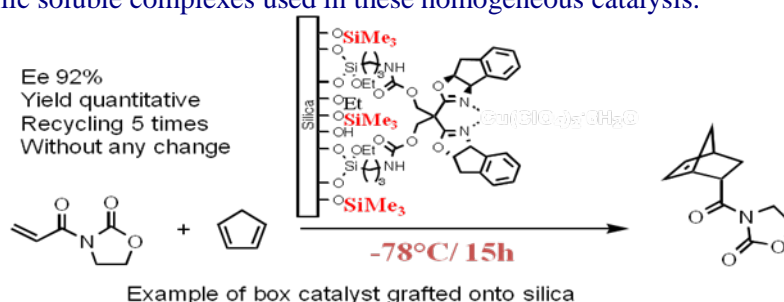
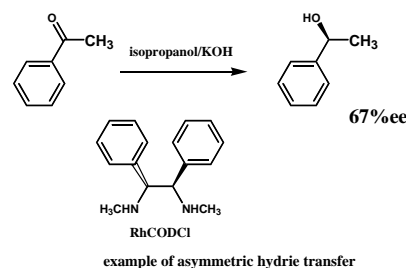
Quantitative yield
example of reduction of phosphine oxide

We have described the reduction of phosphine oxide, nitrile or nitro derivatives with good yields and selectivity depending on the catalyst used.

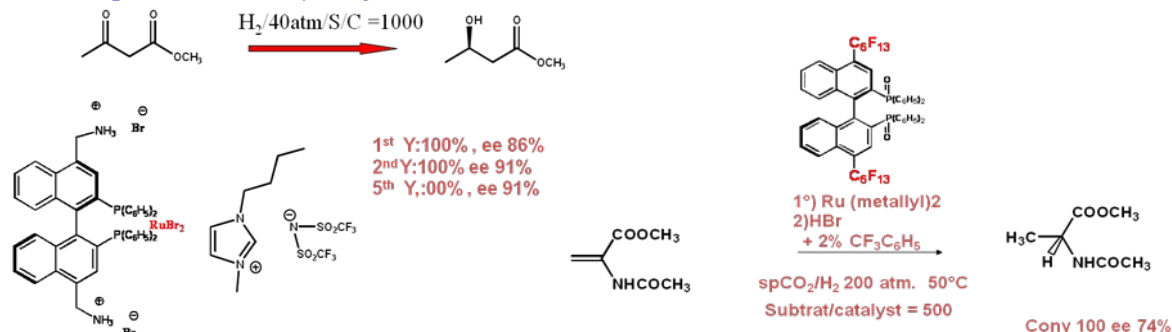
2.2 Asymmetric catalysis

Phosphines are the most important type of ligand but they present several specific drawbacks we were among the first to use successfully nitrogen containing ligands for the asymmetric hydride transfer. The review we published in 2000 on this subject was cited about 500 times.

The last decade asymmetric catalysis had become one of the most important areas of research in both academic and industrial laboratories. Nevertheless, only relatively few industrial processes use this technology. We believe that this slow development is mainly due to the price and the toxicity of the organometallic soluble complexes used in these homogeneous catalysis.



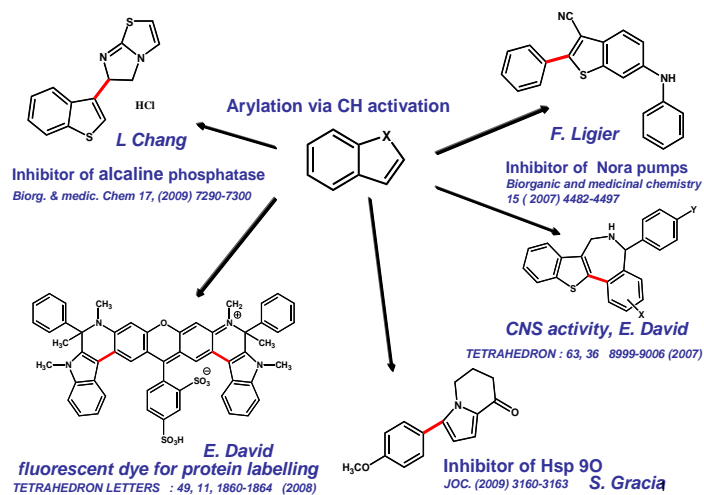
Therefore we developed new asymmetric catalysts as efficient and selective as their homogeneous counterpart but easy to separate and recycle. We have synthesized and successfully used homogeneous supported and water soluble catalysts as well as catalyst efficient and selective in super critical CO₂ or Room Temperature Ionic Liquid. Diamine, salem, and binap were successfully modified in order to easier separation and recycling in such solvent and/or conditions.



Example of asymmetric reduction in ionic liquid and super critical CO₂

3° Synthesis and evaluation of biologically active molecules

Research in synthetic methodology described in the previous chapter is used in the synthesis of more complex molecules. We have chosen to use our technologies in medicinal chemistry in the frame of several cooperations with biochemistry or biologic laboratories. The formation of aryl aryl bond by CH activation appeared to be very useful in this particular field. For example we have described new efficient inhibitors of the Nora pumps which are responsible for the multidrug resistance of bacteria (cooperation with J.M. Paris, ENSCParis), inhibitors of non specific alkaline phosphatase responsible for the arthritis disease (cooperation with Professor R. Buchet, ICBMS) and new fluorescent rhodamine usable for proteins labelling (cooperation with Dr A. Desronziers UJF, Grenoble). Several other series of molecules are currently under testing in the field of inhibitor of protein "chaperonne" HSP90 and molecules active on the CNS.



Examples of use of CH activation in medicinal chemistry

Using a modification of the Pictet-Spengler reaction as well as an original synthetic pathway we have synthesized analogs of phthaliscidine, an efficient anti cancer drug discover by E.J.Corey during his study of the ecteinascidine. All the molecules synthesized are being tested in cooperation with other academic laboratories.