# Green Chemistry Group

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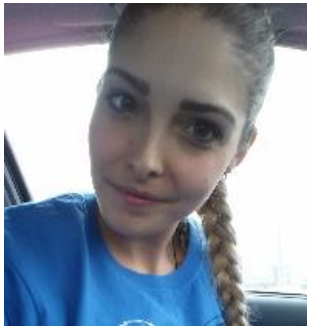

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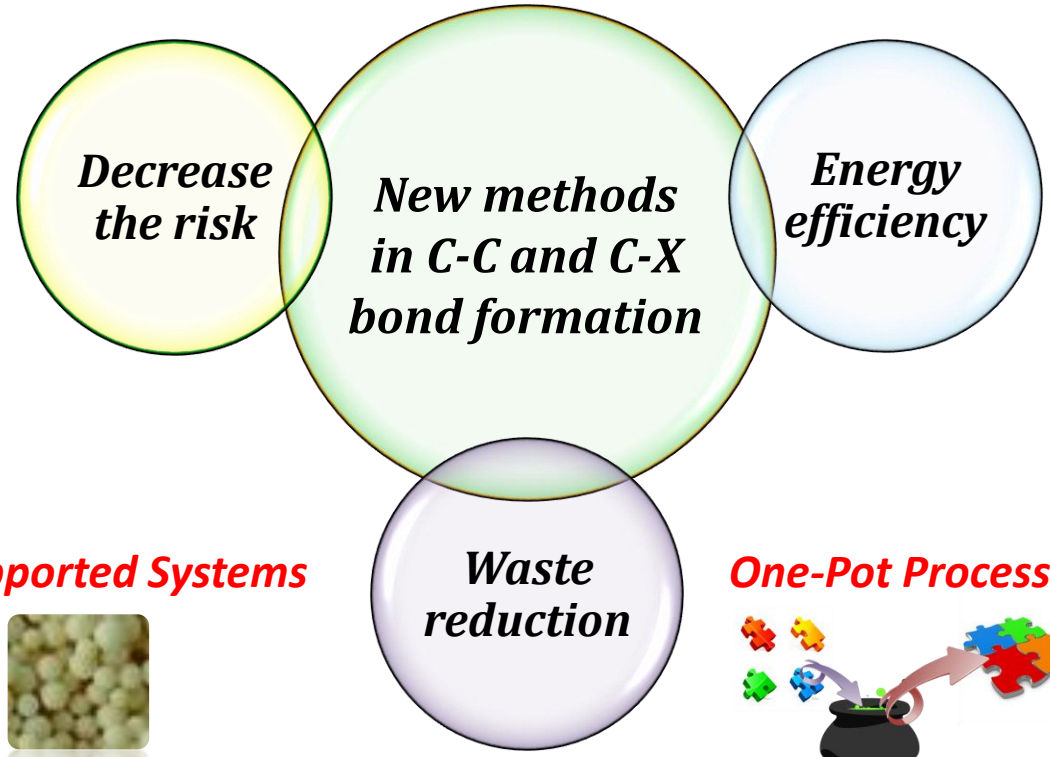
# ? Green Chemistry Group ?




**Green Solvents**

Green Solvents For Synthesis
Alternative Fluids in Science and Application

**Flow Chemistry**

**Solid Supported Systems**



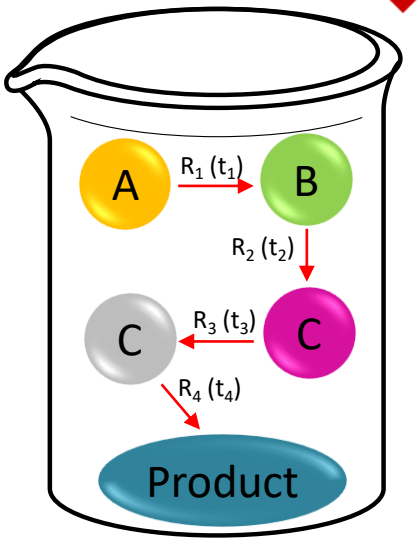
**One-Pot Processes**

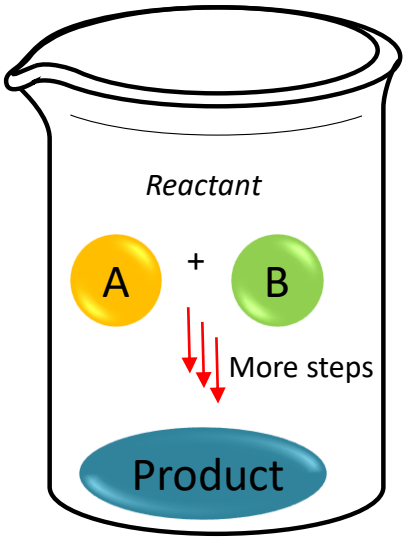


*Green chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products.*

- **Development of new one-pot and domino processes**

A **one-pot process** refers to the conversion of molecule into the final target occurring in the same reactor and avoiding the isolation of any intermediates. This proccess involves a sequence of transformations by adding components at specific time intervals.



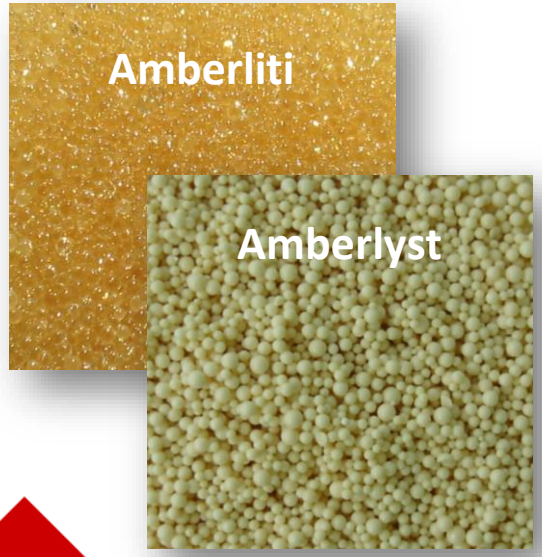



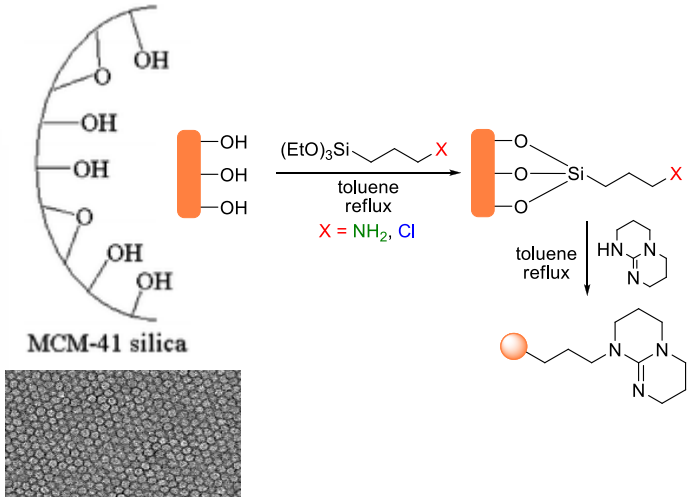

In a **domino process** all reaction components are mixed together for giving, under the same conditions and after a series of transformations, the desired product.

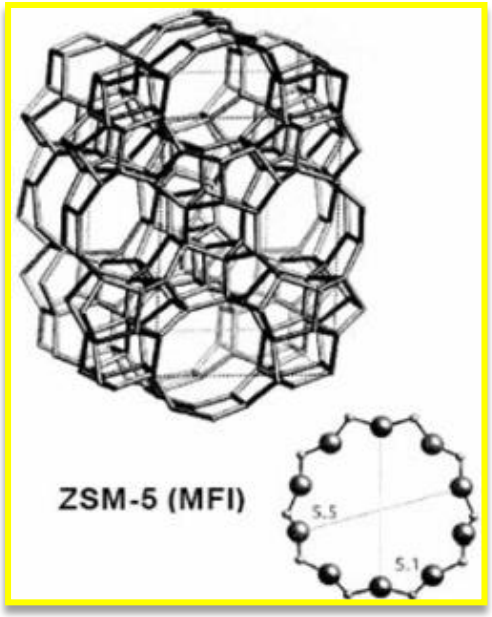
Avoiding the isolation and purification of intermediates, both approaches are considered nowadays useful tools for limiting the waste generation and the energy consumption according to the green chemistry principles.

- **Preparation and synthetic application of solid supported systems**

The importance of heterogeneous systems is highlighted by the growing numbers of papers that are published on this topic every year. In fact, by a carefully selection of the heterogeneous system, it is possible to increase the chemo-, regio- and stereoselectivity of a reaction, and to replace stoichiometric toxic species with easy to handle and often recyclables ones.



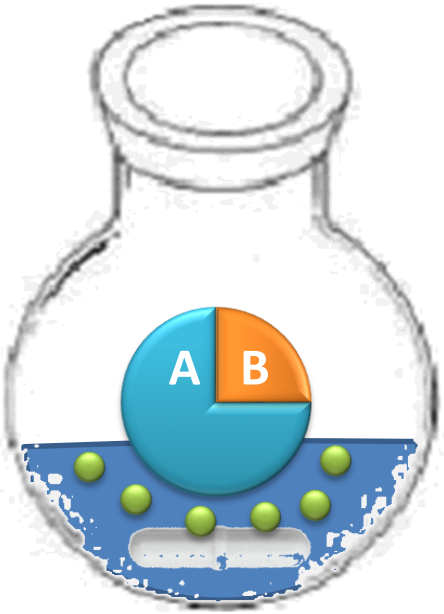
- **Preparation and synthetic application of solid supported systems**

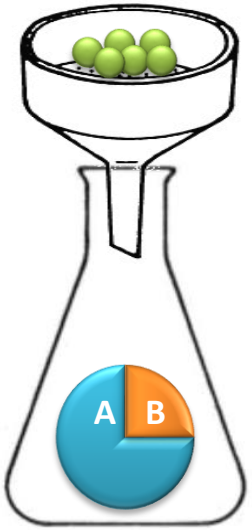
Moreover, the use of solid systems with respect to their homogeneous counterparts, allows to:

(i) Minimize the release and/or exposure issues with evident advantages from the sustainable viewpoint.

(ii) Switch from complicated work-ups to simple filtrations.

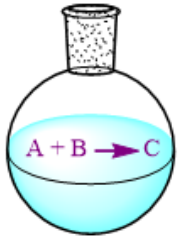

***COMMON REACTION PROMOTED BY A HETEROGENEOUS CATALYST***



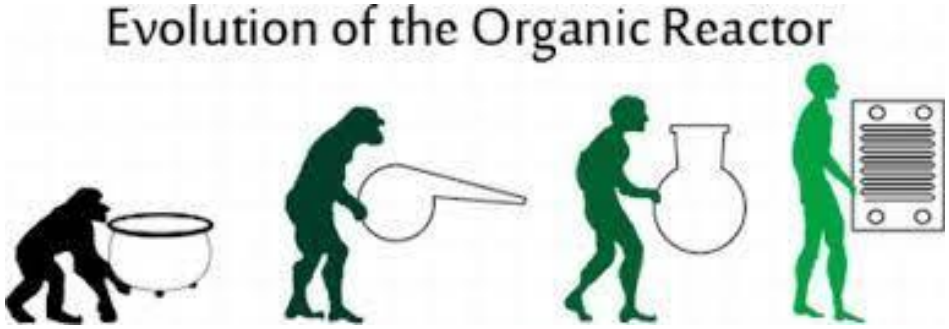



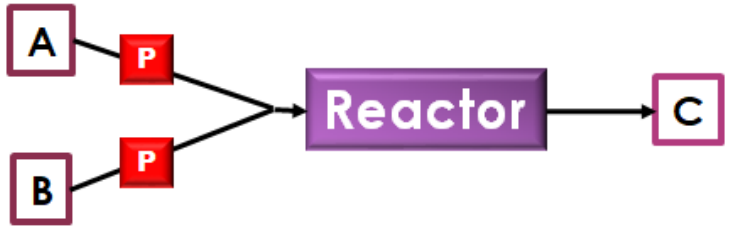
- **Study of new flow chemical protocols**

In a flow process, pumps move fluid into a tube, and where tubes join one another, the fluids contact one another. If these fluids are reactive, a reaction takes place. Flow-chemistry has been developing in the last two decades, and it can be considered a connection between laboratory research and industry.




*Batch process*



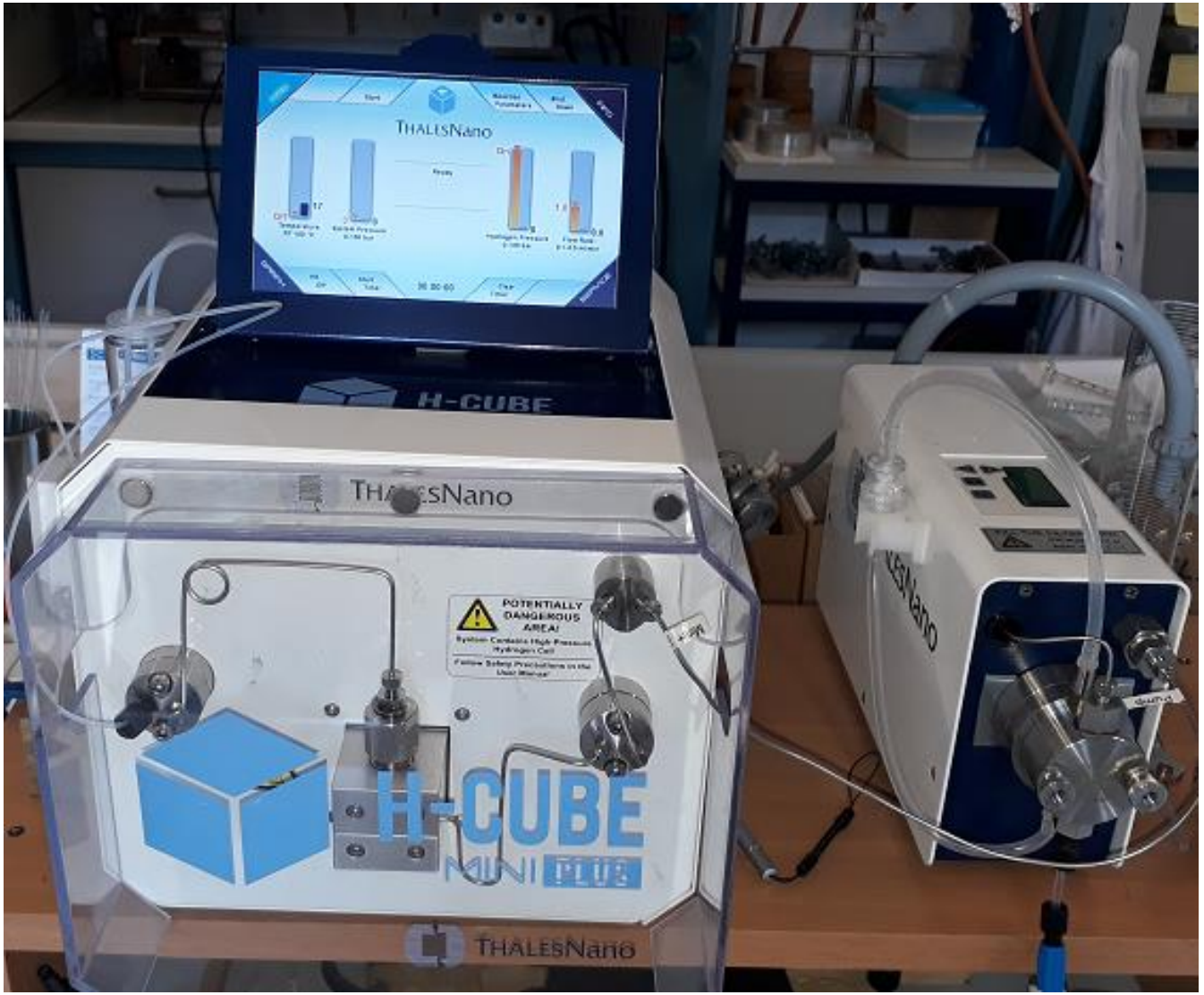




*Flow process*

- **Study of new flow chemical protocols**

Flow technique vs the batch chemistry, brings considerable advantages in synthetic procedures such as:

- *Better control on heat transfer and on other reaction parameter*
- *Increased mixing ability*
- *Easy to scale-up*
- *Simplicity to perform serial reactions*
- *Controlled use of toxic materials*
- *Controll of reactive and unstable intermediates.*


THALESNano
H-CUBE
POTENTIALLY DANGEROUS AREA!
H-CUBE
MINI PLUS
THALESNano


asia
syrris
asia
pressurized input store
Pressurized system, read manual before use.
Only use with Syrris certified bottles.
asia
heater
106.8
CAUTION BURNS
asia
pressure controller
45

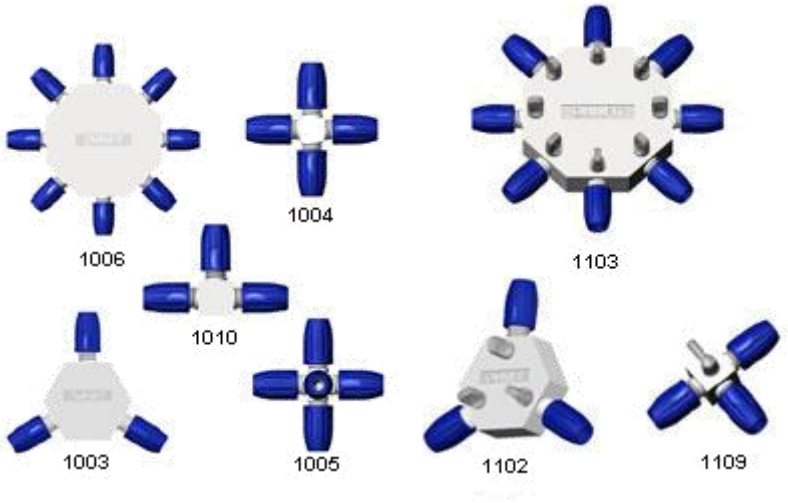
T-Mixer

Reactor

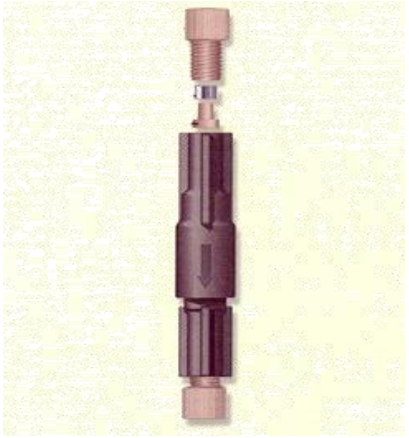
## Reactors

- Pressure ratings to 1200 psi (80 bar)
- Solvent resistant
- Fixed or adjustable height

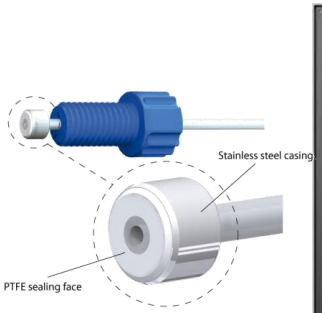
## Connectors



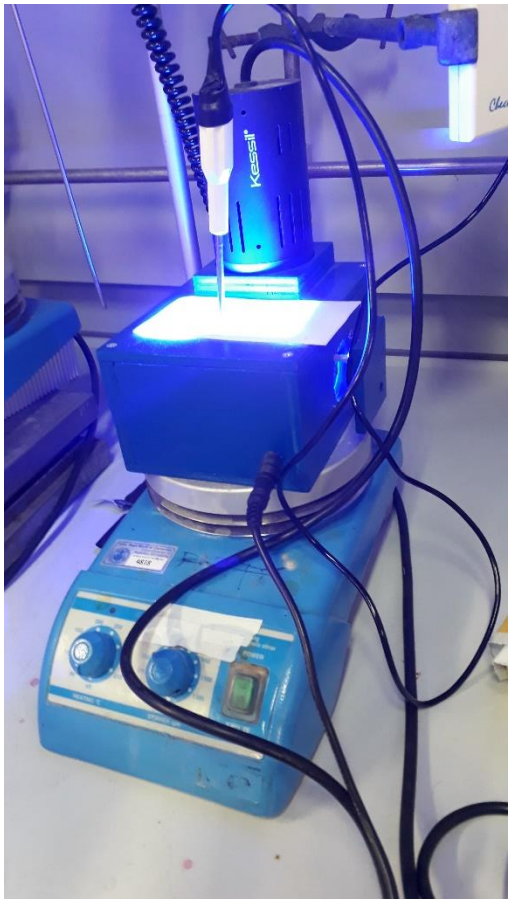

## Back Pressure Regulator



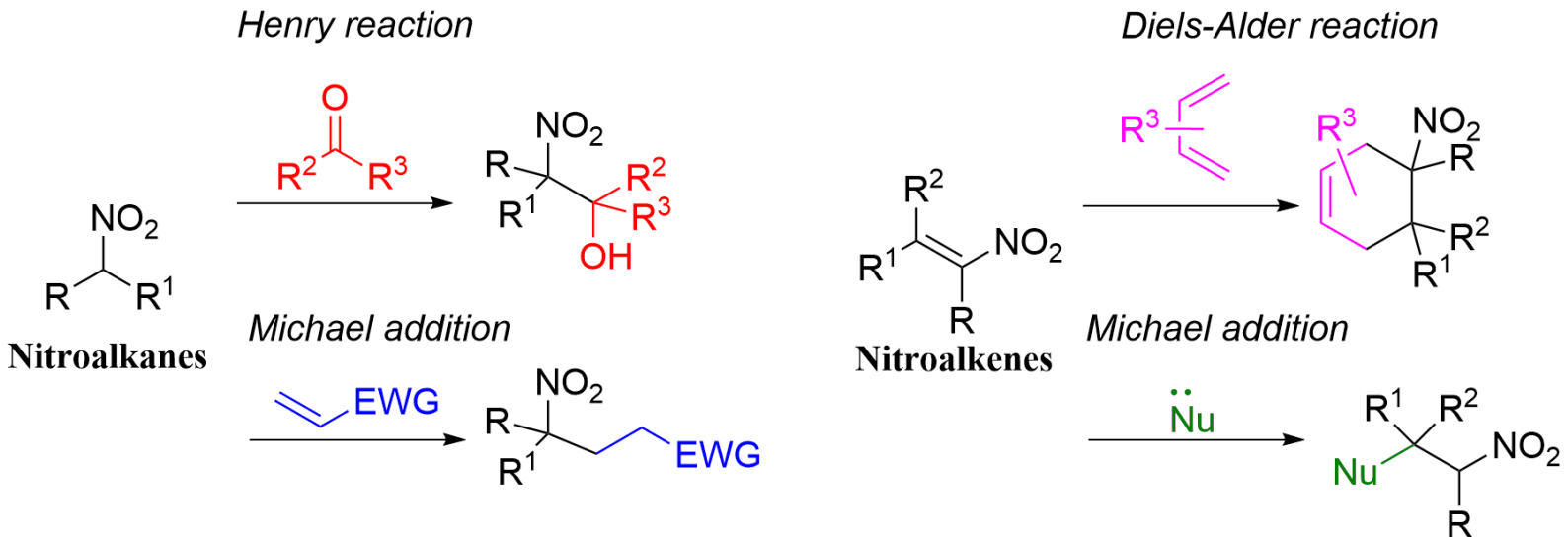
## Cables




## Other synthetic green approaches

## Chemistry of aliphatic nitro compounds

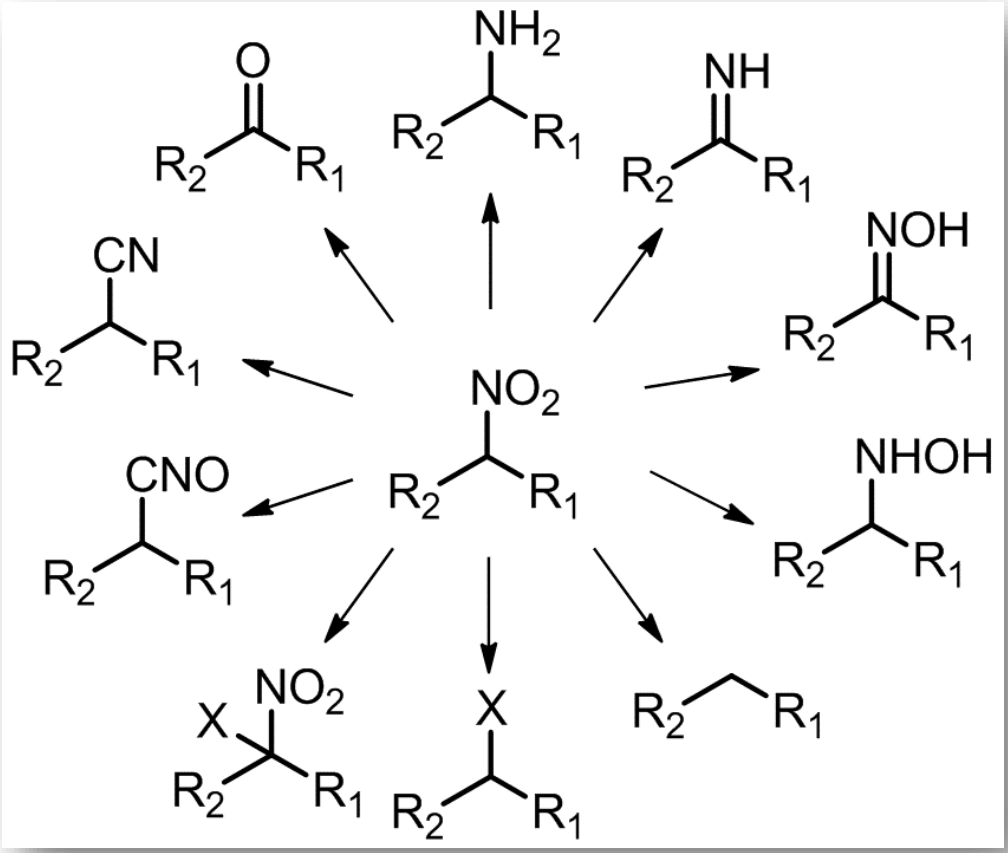



Aliphatic nitro compounds are strategic reagents in organic synthesis to generate new carbon-carbon and carbon-heteroatoms bonds. They can be classified in nitroalkanes, generally involved in Henry or Michael reactions, and nitroalkenes which are extraordinary Michael acceptors and useful dienophiles in Diels-Alder reactions.

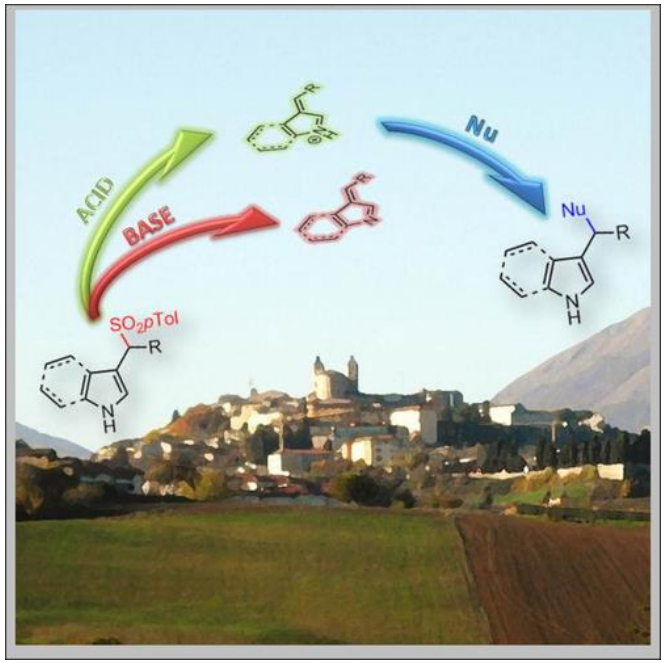
## Nitro group

*Chemical*

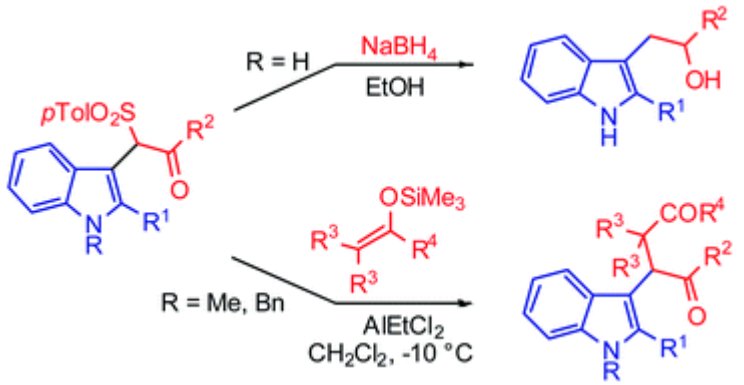
*Chameleon*



# Chemistry of heterocyclic system derivatives

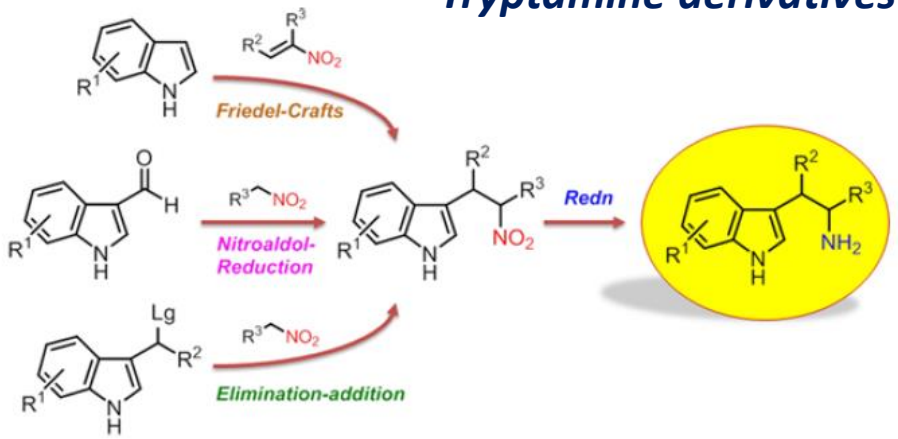



*Indole derivatives*

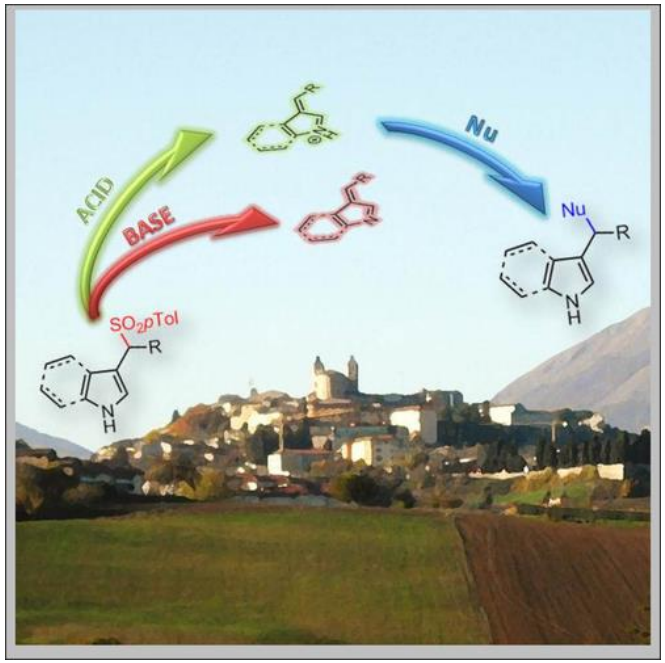



*Tryptophols derivatives*

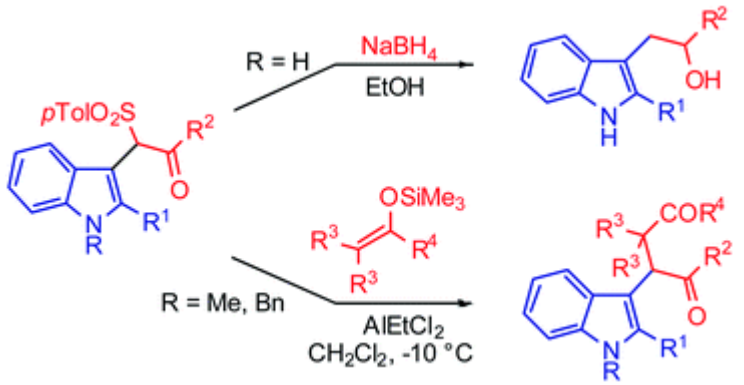
*Tryptamine derivatives*



# Chemistry of heterocyclic system derivatives

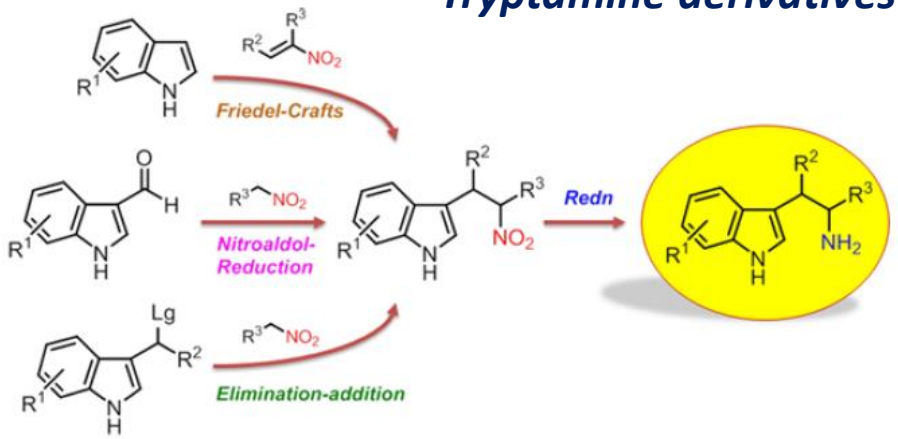



*Indole derivatives*



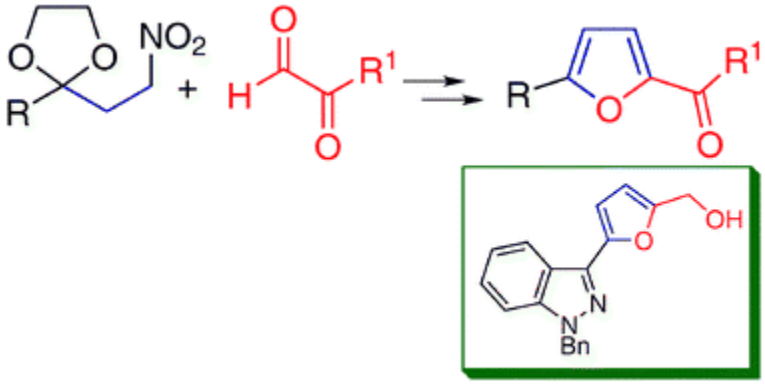

*Tryptophols derivatives*

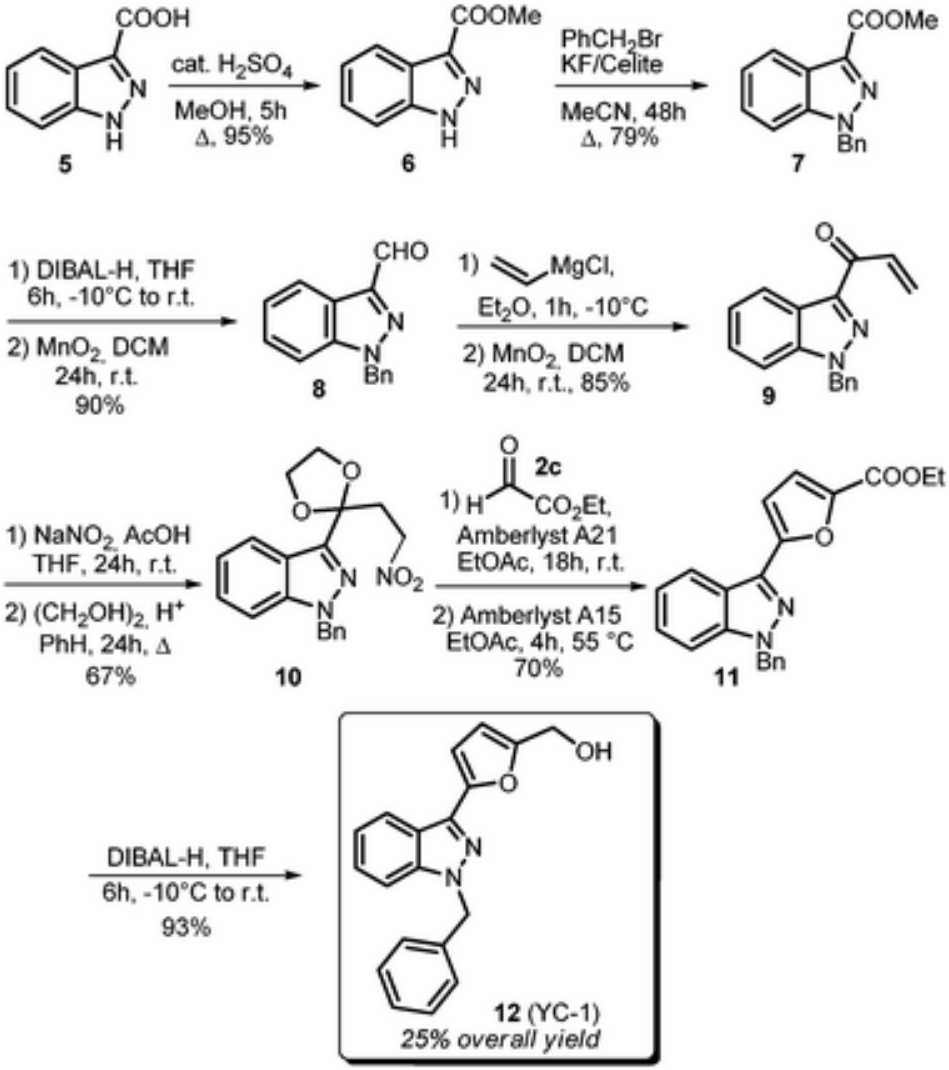
*Tryptamine derivatives*



## Some synthesized targets

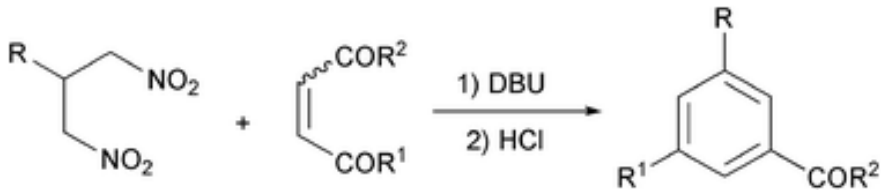
Synthesis of 2,5-disubstituted furan derivatives from functionalized nitroalkanes: successive Amberlyst A21- and Amberlyst 15-catalyzed processes.

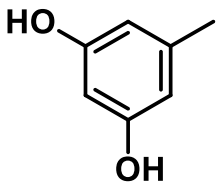


## Some synthesized targets

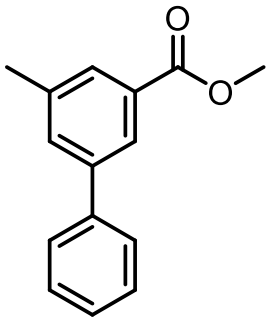
One pot synthesis of 3,5-alkylated acetophenone and methyl benzoate derivatives.

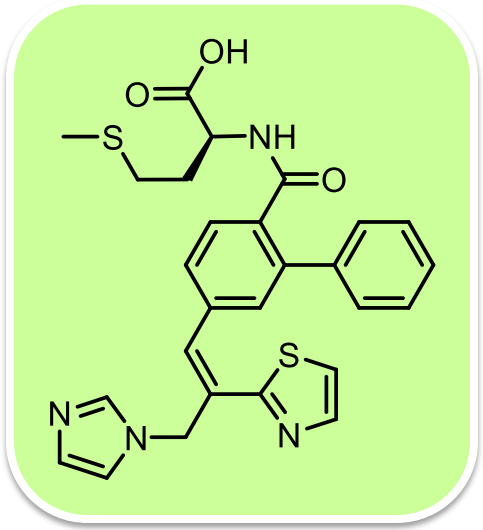



Orcinole

8 step
3%



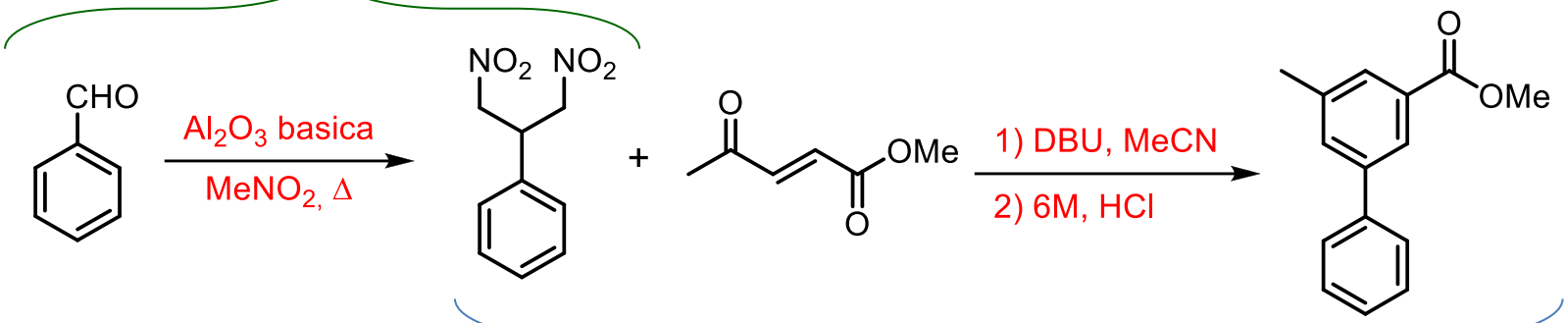




**INIHBITOR of proteinfarnesyltransferase**

Boyle, F. T.; Davies, G.M. ; Wardleworth, J.M.; Arnould, J.C. "*Imidazolyl Compounds as Inhibitors of Farnesyl-Protein Transferase*" US Pat., 6 414 145 B1, **2002**.

## Some synthesized targets

**Domino process 71%**

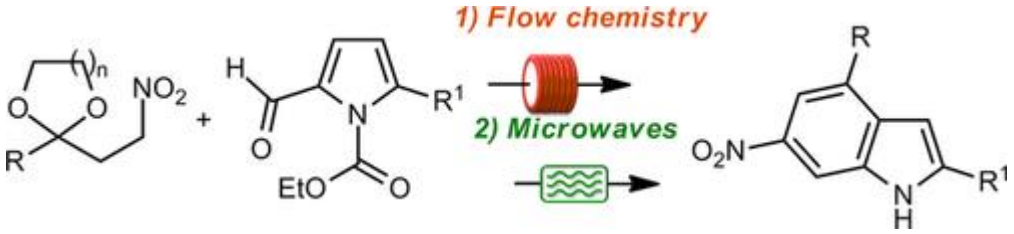


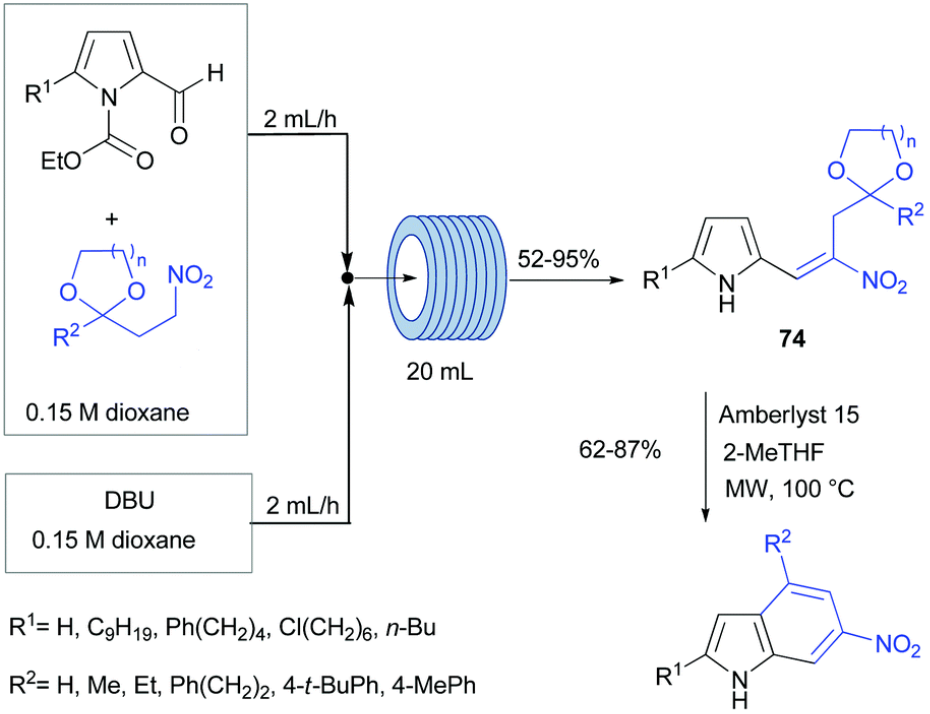

**Domino process 72%**

**Overall yield : 51%**

## Some synthesized targets

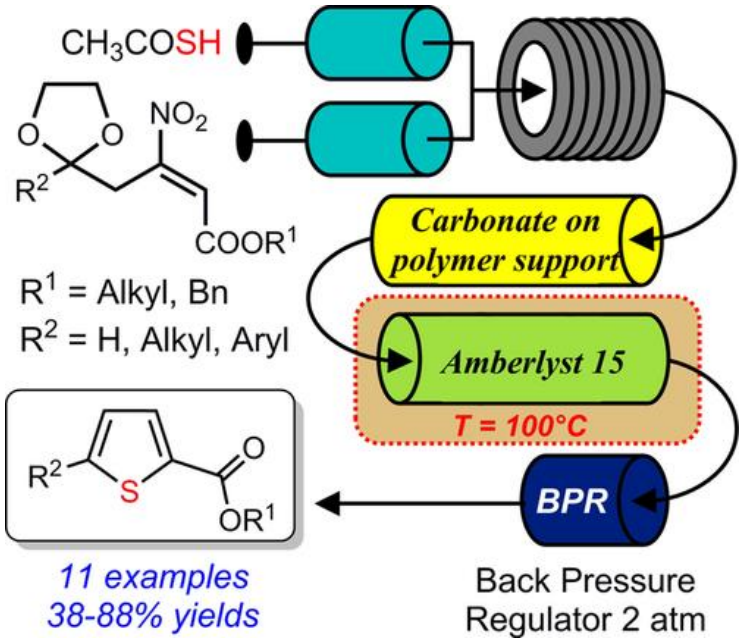
**Two-Step Synthesis of Polysubstituted 6-Nitroindoles under Flow Chemical and Microwave Conditions.**

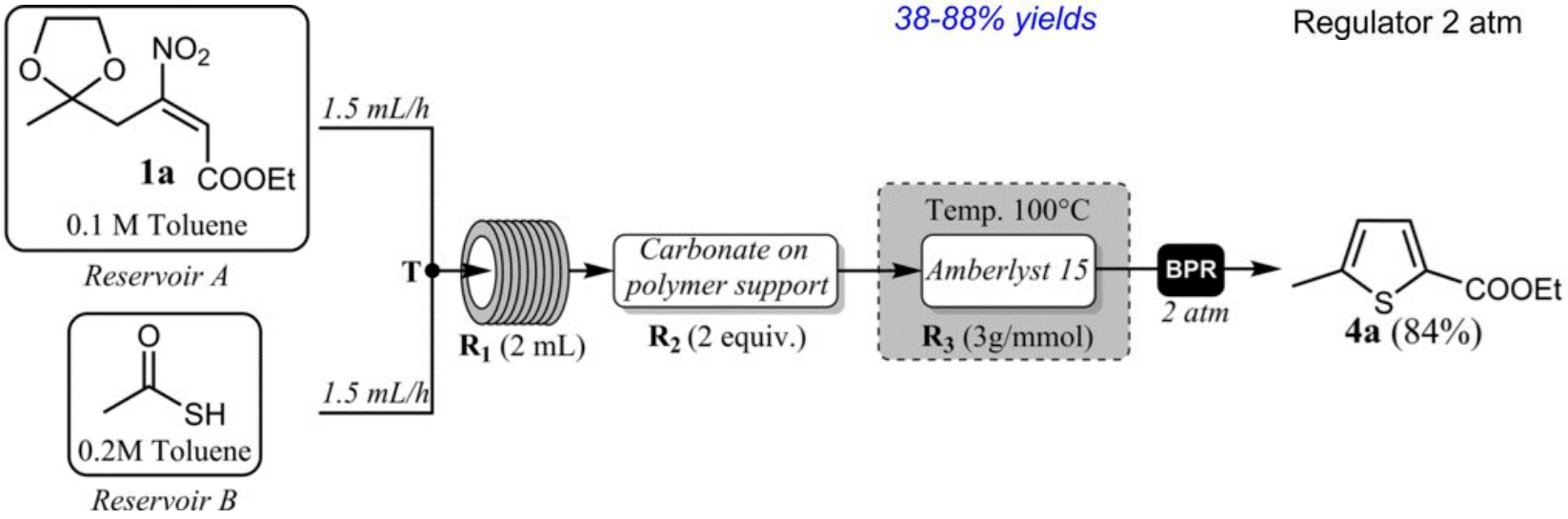


## Some synthesized targets

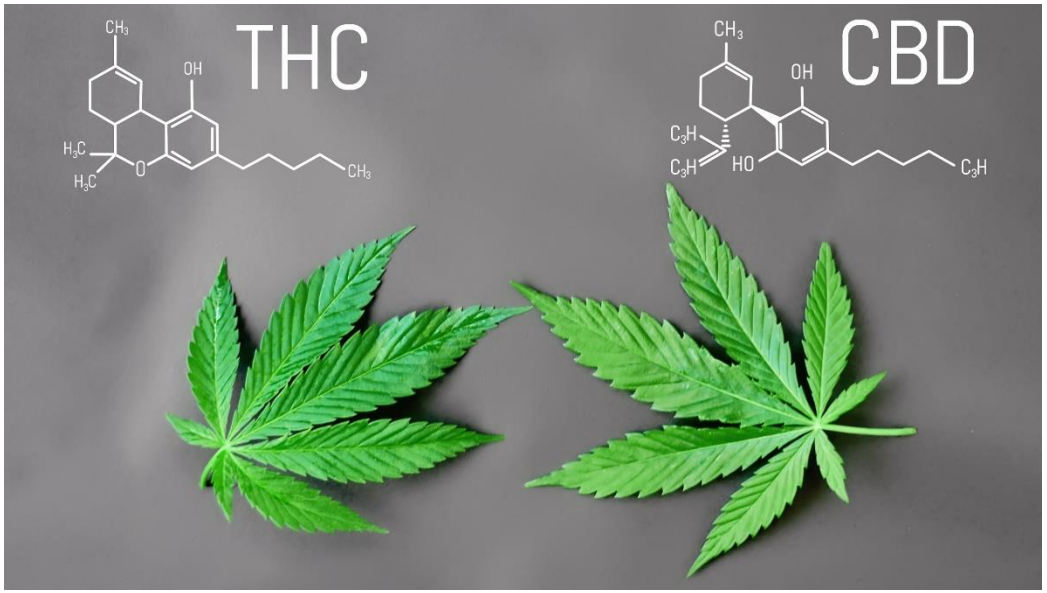
**β-Nitroacrylates as Starting Materials of Thiophene-2-Carboxylates Under Continuous Flow Conditions.**



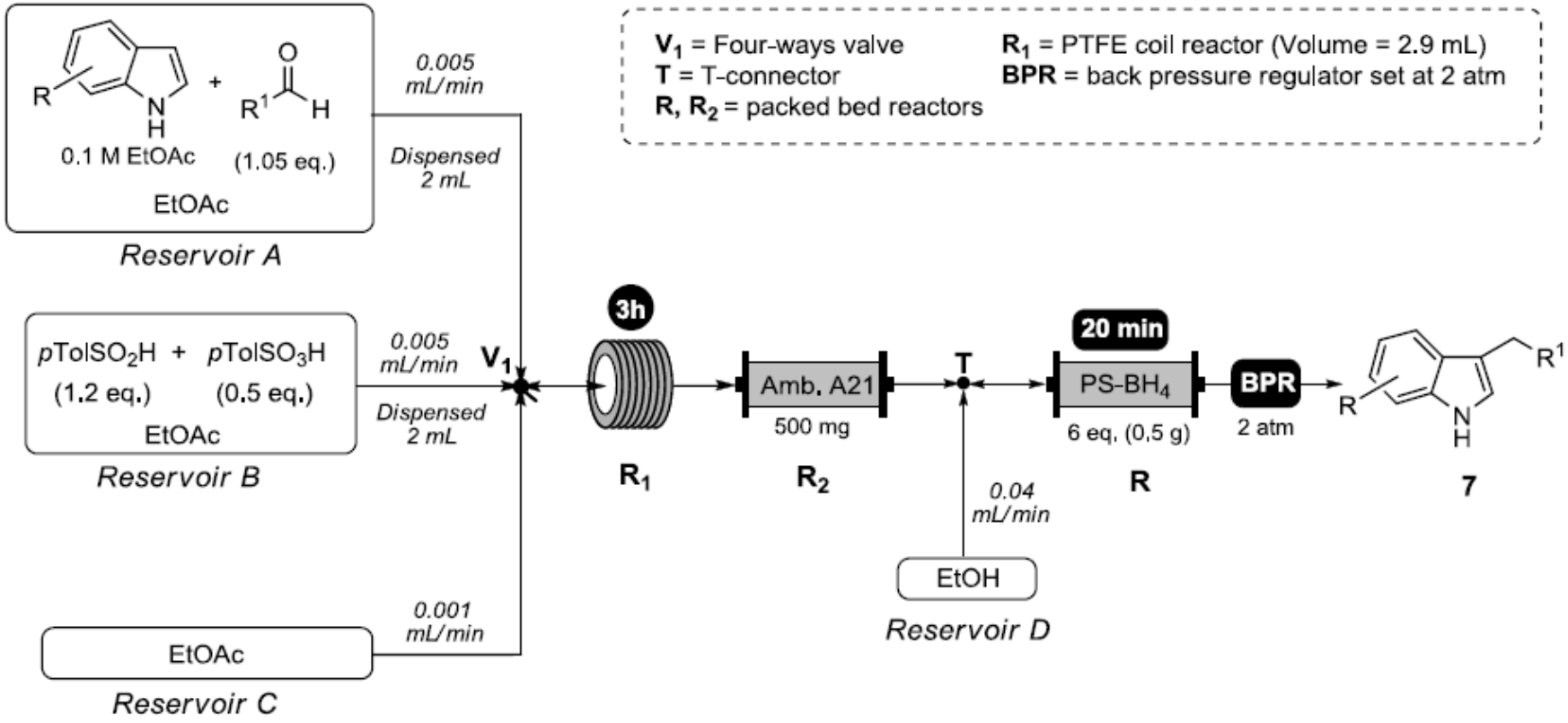
## Some synthesized targets

**A Novel and Practical Continuous Flow Chemical Synthesis of Cannabidiol (CBD) and its CBDV and CBDB Analogues.**

## Some synthesized targets

**3-Alkylated indoles by reduction of sulfonyl indoles under flow chemical conditions.**




"THAT'S THE END OF MY PRESENTATION. ANY QUESTIONS?"