

New technologies helping
synthetic chemists



UNIVERSITÀ
DEGLI STUDI DI BARI
ALDO MORO

Department of Pharmacy
Drug Sciences

FLAME – Lab Flow Chemistry and Microreactor Technology Laboratory

With 400 k€ investment in scientific equipment, a new lab specialized in microreactor technology and flow chemistry has been created at the Department of Pharmacy of the University of Bari. The aim of the lab is to explore new chemistry contributing to the increasing need for a sustainable development. The lab furnishes facilities, expertise and collaborative support to industries and academic institutions involved in developing continuous flow synthetic processes and new synthesis.

Meeting the Green Chemistry Principles

1. Prevention *
2. Atom Economy *
3. Less Hazardous Chemical Syntheses *
4. Design Safer Chemicals
5. Safer Solvents and Auxiliaries *
6. Design for Energy Efficiency *
7. Use Renewable Feedstocks
8. Reduce Derivatives *
9. Catalysis *
10. Design for Degradation
11. Real-time Analysis for Pollution Prevention
12. Inherently Safer *

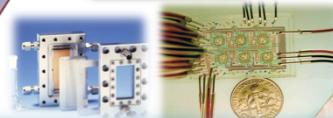
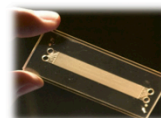
* Principles addressed by Microreactor Technology

Development of a sustainable chemistry

Batch chemistry

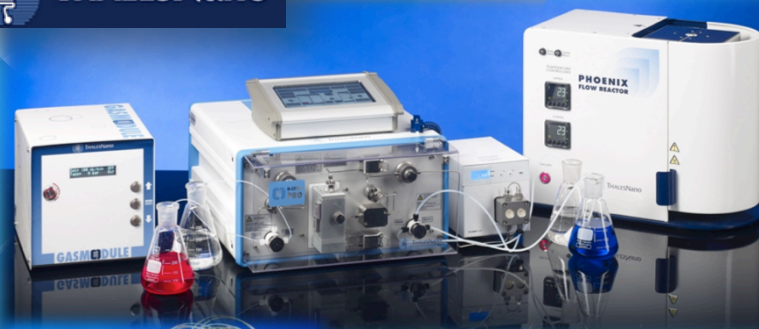


Microreactor technology



Faster
Safer
Cleaner
Cheaper

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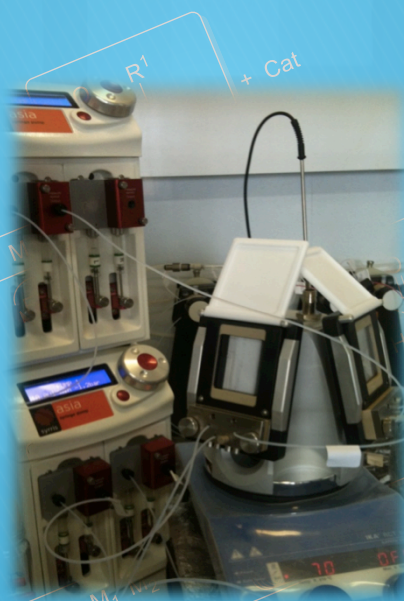


H-Cube pro™ with Phoenix™ Flow Reactor

Thalesnano Flow Reactors for homogenous and heterogeneous reactions such as cross coupling reactions, heterocycle synthesis, condensation, liquid-gas reactions. The gas module is able to handle up to 13 different gases. Expand chemistry by using parameter space not achievable on standard lab equipment.



O-Cube™ easy Ozonolysis and more!



Syrris Asia™ flow system with glass chip microreactors for homogenous reactions such as organocatalyzed reactions, and tube reactors for coupling and organometallic chemistry. Highly accurate delivery of reactant solutions.

Go with the flow!

Chemistry Benefits:

- ✓ New chemical routes
- ✓ Improved yield and selectivity
- ✓ Increased reaction rate
- ✓ Expanded temperature range
- ✓ Excellent temperature control
- ✓ New reactions are possible
- ✓ Optimization and mechanistic studies

Safety Benefits:

- ✓ Enhanced safety
- ✓ No scale up issues
- ✓ No unstable intermediates accumulation
- ✓ Elimination of batch critical operation
- ✓ Minimal reagent volumes
- ✓ Reduced solvent usage

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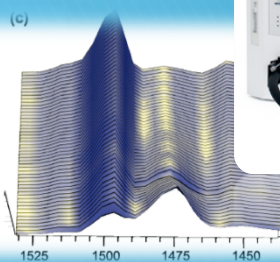
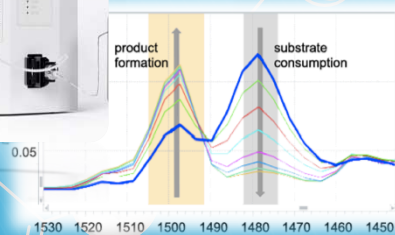
Interdigital micromixer and T-shaped micromixer for very fast reactions involving highly unstable reactive intermediates (es. Organolithiums or Grignard reagents).



Vapourtec R series equipped with high and low (up to -70°C) temperature loop reactors for synthesis of heterocycles, organometallic chemistry and reactions under homogenous conditions. In-line UV and FT-IR monitoring.



In-line FT-IR monitoring for batch and flow processes. Reaction optimization never been so easy!



Go with the flow!

Microreactor Features:

- ✓ Continuous process
- ✓ Reduced process hold up
- ✓ Residence time control
- ✓ Efficient mixing
- ✓ High surface to volume ratio
- ✓ Improved process control
- ✓ Linear scale up by numbering up
- ✓ Work above solvent boiling point
- ✓ Easy to clean or replace

Economy Benefits:

- ✓ Less capital risk
- ✓ Lower manufacturing and operating cost
- ✓ Less raw material, solvent, waste, energy..
- ✓ Less work up
- ✓ Constant quality
- ✓ Shorter time to market
- ✓ Improved production management
- ✓ (on-site & on-demand chemistry)

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References:

- K. Jhnisch, V. Hessel, H. Lwe, M. Baerns *Angew. Chem. Int. Ed.* **2004**, 406.
- T. Wirth *Microreactors in Organic Synthesis and Catalysis* **2008**, Wiley – VCH.
- D. Zhao, K. Ding *Recent Advances in Asymmetric Catalysis in Flow* DOI: 10.1021/cs300830x.
- *Microreactors in Preparative Chemistry: Practical Aspects in Bioprocessing, Nanotechnology, Catalysis and more*, W. Reschetilowski Ed., Wiley **2013**.

Recent publications from the Lab:

- L. Carroccia, B. Musio, L. Degennaro, G. Romanazzi, R. Luisi (2013). *Microreactor-Mediated Organocatalysis: Towards the Development of Sustainable Domino Reactions*. JOURNAL OF FLOW CHEMISTRY, vol. 4, p. 29-33, ISSN: 2062-249X.
- A. Giovine, B. Musio, L. Degennaro, A. Falcicchio, A. Nagaki, J. Yoshida, Luisi R (2013). *Synthesis of 1,2,3,4-Tetrahydroisoquinolines by Microreactor-Mediated Thermal Isomerization of Laterally Lithiated Arylaziridines*. CHEMISTRY-A EUROPEAN JOURNAL, vol. 19, p. 1872-1876, ISSN: 0947-6539.
- R. Luisi, B. Musio, L. Degennaro, (2011). *Microreactor Technology as Tool for the Development of a Sustainable Synthetic Chemistry*. LA CHIMICA E L'INDUSTRIA, p. 114-123, ISSN: 0009-4315.

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MINISTERO DELL'UNIVERSITA' E DELLA RICERCA
MINISTERO DEL LAVORO, SALUTE E POLITICHE SOCIALI



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Research, Application,
Innovation, Services in
Biomedicine

