



POLITECNICO DI MILANO
Dipartimento di Chimica Materiali e Ingegneria Chimica
“Giulio Natta”

RESEARCH GROUP ON CATALYSIS AND CATALYTIC REACTION ENGINEERING

EUROKIN
Billingham – UK
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Enrico Tronconi

Composition

➤ **Group Leader:**

Pio Forzatti

➤ **Academic staff:**

Prof. Pio Forzatti

(full professor)

Prof. Enrico Tronconi

(full professor)

Prof. Luca Lietti

(full professor)

Prof. Gianpiero Groppi

(associate professor)

Prof. Alessandra Beretta

(associate professor)

Prof. Cinzia Cristiani

(associate professor)

Dr. Ing. Isabella Nova

(assistant professor)

➤ **Post-Doctoral Positions:**

Dr. Natale Ferlazzo

(senior researcher)

Dr. Ing. Michela Valentini

➤ **Technicians:**

Mrs. Giuseppina Gasti

Mr. Enrico Aliprandi

Mrs. Enrica Ceresoli

➤ **PhD Students:**

Dott. Lidia Castoldi

Ing. Mario Galbiati

Dott. Cristian Ciardelli

Ing. Raffaella Villa

Ing. Ivan Tavazzi

Ing. Francesco Fiore

Ing. Leonardo Giani

Ing. Chiara Gambaro

Ing. Tiziana Bruno

➤ **Postgraduate students:**

Ing. Andrea Vailati

Ing. Andrea Scotti

Undergraduate Students (involved in Master's Thesis Works):

~ 20

➤ **Laboratories**

Five laboratories for an overall size of over 300 m²

➤ **Equipment for catalyst preparation, activation**

Equipment for the preparation of catalysts in the form of powder, of granules, of bulk and coated honeycomb and plate-type monoliths, and of various coated structured systems (e.g. foams, fibres).

Equipment for drying and activation of catalysts in air and under controlled atmospheres (including one climatic chamber).

➤ **Equipment for catalyst characterisation**

Several physico-chemical techniques are available, including surface area and pore size distribution measurements (N₂ adsorption-desorption and Hg intrusion), Laser granulometer, viscosimeter, DTA-TG, DSC, XRD, FT-IR, Raman, UV-Vis DR, SEM, TPD/TPO/TPR, TPSR, GC-MS, chemical analysis.

➤ **Equipment for catalyst testing and kinetic studies**

Lab-scale rigs suitable to test:

- a) catalysts in the form of powder (5, 3 with mass spectrometer)*
- b) catalysts in the form of honeycomb or plate-type monoliths (3)*
- c) catalysts in the annular reactor configuration (3)*
- d) catalysts operated under pressure (1, up to 100 bar)*

➤ **Equipment for soil remediation (via thermal treatment)**

Lab scale rig (1)

➤ **Computational facilities**

- a) one workstation*
- b) several connected PCs (LAN)*
- c) software for regression, numerical methods, mathematical modelling and simulation.*

1. NO_x removal from stationary and mobile sources:

- a) SCR process for NO_x removal from stationary sources (power plant flue gases)
- b) SCR for NO_x removal from mobile sources (vehicles)
- c) NO_x trap concept for lean burn mobile engines (Toyota concept)
- d) NO_x trap concept for lean burn combustion stationary applications (SCONOX).

Industrial cooperations with: ENEL, Edison, IHI (Japan), DaimlerChrysler (DE)

2. Catalytic combustion:

- a) adiabatic lean premixed catalytic combustion of methane (and CO/H₂ mixtures) for GT applications
- b) chemical looping combustion

Industrial cooperations with: ENEL, Snamprogetti, IFP, Turbomeca, Volvo, Alstom Power (CH)

3. Soot removal from vehicles:

Preparation and testing of novel catalytic filters

Industrial cooperation with: SAES Getters

4. Novel routes for the exploitation of natural gas

- a) *production of olefins via oxidative dehydrogenation of light paraffins at short contact times*
- b) *catalytic partial oxidation of methane and higher paraffins to CO and H₂ at short contact times*

Industrial cooperation with: Sapio, Alstom Power (CH)

c) Fischer-Tropsch synthesis

Industrial cooperation with: Enitecnologie

5. Selective oxidation:

- a) *n*-butane oxidation to maleic anhydride: kinetic study and fluidised-bed reactor modeling
- b) benzene oxidation to maleic anhydride: kinetic study

Industrial cooperation with: Lonza

6. Oxy-chlorination of ethylene to DCE and cracking of DCE:

- a) *mathematical modelling of air- and oxygen-based oxy-chlorination of ethylene to di-chloro-ethane in fixed bed reactors*
- b) *modelling of thermal cracking of DCE to VCM*

Industrial cooperation with: EVC (Ineos)

7. Use of monolithic reactors under non-adiabatic conditions:

- a) development of discrete and continuous mathematical models
- b) experimental study and modeling of thermal and catalytic performances of innovative metallic structured catalysts with high thermal conductivity

Industrial cooperation with: Corning

8. Mass- and heat-transfer properties of structured catalysts based on metallic foams:

experimental study and modeling of thermal and catalytic performances of washcoated metallic foams

9. Forming of structured items:

- a) coating of ceramic and metallic structured catalysts
- b) extrusion of honeycomb catalysts
- c) extrusion of concrete materials

Industrial cooperations with: EVC, Italcementi,

10. Soil remediation

thermal treatment of soil contaminated with lead and organic compounds

PREVIOUS RESEARCH EXPERIENCE

Selective oxidation:

- a) oxidation of methanol to formaldehyde in fixed bed and in fluidised bed;
- b) oxyesterification of methanol to methyl formate;
- c) oxidation of ethylene to ethylene oxide (lab scale and pilot plant);
- d) oxidation of propylene to acrolein and to acrylic acid; two steps oxidation of propylene to acrylic acid (lab scale and pilot plant);
- e) ammoxidation of propylene to acrylonitrile (lab scale, pilot plant and full scale plant);
- f) oxidation of butenes to butadiene and to maleic anhydride;
- g) two steps oxidation of isobutene to methacrylic acid (lab scale and pilot plant);
- h) epoxidation of cyclohexene and propylene to the corresponding epoxides;
- i) dye sensitised photo-oxygenation of olefins to the corresponding hydroperoxides;
- l) oxidative coupling of methane to C2 hydrocarbons.
- m) oxidation of p-methoxy-toluenes to p-methoxy-benzaldehyde (with Tessederlo)

Hydrogenation:

- a) synthesis of methanol and higher alcohols from CO/H₂ (lab scale, pilot plant and demonstration plant) (with Snamprogetti);
- b) hydrogenation of CO to CH₄.

Catalytic combustion:

- a) catalytic combustion of natural gas in domestic burners