

# EuChemS Historical Landmarks Award

Un Premio Nobel per un grande Futuro  
Conferenze @ Dipartimento "G. Natta"

Sala Natta | Politecnico di Milano, ed. 6  
Piazza Leonardo da Vinci 32 | Milano

*Chairperson*

Prof. Maurizio S. Galimberti

**28 Maggio 2024 | 14.30**

## CATALISI

Luigi Cavallo | King Abdullah University of Science and Technology, Thuwal, Arabia Saudita  
Fabrizio Piemontesi | LyondellBasell

**13 Giugno 2024 | 14.30**

## POLIMERIZZAZIONE

Vincenzo Busico | Università di Napoli  
Simona Losio | Scitec - CNR, Milano  
Giovanni Ricci | Scitec - CNR, Milano

**19 Settembre 2024 | 14.30**

## PROCESSI

Flavio Manenti | Politecnico di Milano  
Paolo Vincenzi | LyondellBasell, Centro Ricerche G. Natta, Ferrara

**10 Ottobre 2024 | 14.30**

## MATERIALI

Gaetano Guerra | Università di Salerno  
Claudio Cavalieri | LyondellBasell, Centro Ricerche G. Natta, Ferrara

**15 Novembre 2024 | 14.30**

## CIRCOLARITÀ

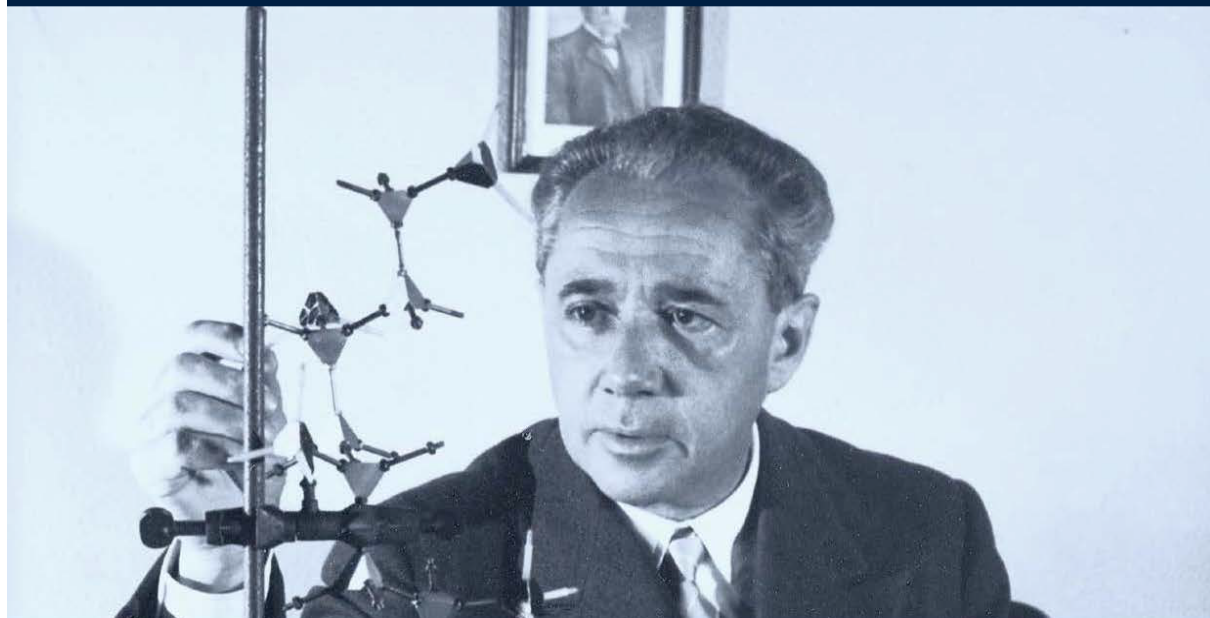
Tiziano Faravelli | Politecnico di Milano  
Vincenzo Lumia | Federchimica - PlasticsEurope Italia  
Stefano Turri | Politecnico di Milano  
Marinella Levi | Politecnico di Milano



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# EuChemS Historical landmarks Award

28<sup>th</sup> May 2024 - 15<sup>th</sup> November 2024

## A Nobel Prize for a great future

*Chairperson*

**Maurizio Galimberti**

Politecnico di Milano. Dipartimento di Chimica, Materiali, Ingegneria Chimica



Maurizio Galimberti is a full professor at the Politecnico di Milano. He teaches Chemistry and Chemistry for sustainable polymers. Degree in Industrial Chemistry from the University of Milan. Former manager at Montell and Pirelli. He is the author of more than 120 publications in international scientific journals, 300 communications at conferences and 100 patent applications. He received several national awards and the George Stafford Whitby Award for Distinguished Teaching and Research from the American Chemical Society Rubber Division.

Former President of AIM (Italian Association of Science and Technology of Macromolecules), he is the Scientific Coordinator of Assogomma's technical training and Coordinator of the Commission for Relations with Industry of the Italian Chemical Society.

His interests span from biobased chemicals and polymers to polymer nanocomposites.

### **Abstract**

“Nature synthesizes many stereoregular polymers, for example, cellulose and rubber. This ability has so far been thought to be a monopoly of Nature operating with biocatalysts known as enzymes. But now Professor Natta has broken this monopoly.”

“Professor Natta. You have succeeded in preparing, by a new method, macromolecules having a spatially regular structure. The scientific and technical consequences of your discovery are immense and cannot even now be fully estimated”.

This was said to Giulio Natta at the Nobel Prize ceremony.

The discoveries of Giulio Natta were indeed revolutionary: he opened the era of stereospecific polymerization. It is frequently asserted that Giulio Natta was awarded the Nobel Prize in recognition of his discovery of isotactic polypropylene. However, this polymer is only the most famous and the most important on an industrial scale.

The lectures @Department G. Natta of Politecnico di Milano tell us about the immense consequences of Giulio Natta's discoveries and tell us about the future: the Natta's legacy is indeed the paradigm for the development of materials inspired by sustainability.

# Catalysis

28<sup>th</sup> May 2024

## The Evolution of Stereoselective Olefin Polymerization Modeling. From Stick and Ball Rationalization to Machine Learning Engineering

### Luigi Cavallo

King Abdullah University of Science and Technology (KAUST)  
4700 KAUST, 23955-6900 Thuwal (Saudi Arabia)



Prof. Luigi Cavallo earned his Ph.D. in 1991 at the University of Naples. From 1994 to 2001 he was an assistant professor of industrial chemistry at the University of Naples. In 2002, he moved as associate professor of industrial chemistry to the University of Salerno. In 2011 he joined the King Abdullah University of Science and Technology, where he serves as Professor of Chemistry. He learned DFT in the group directed by Tom Ziegler, University of Calgary, Canada. He has been recipient of the 2002 - 12th Edition of the Prize "Bright Future in Chemistry", awarded by the Italian Association of Chemical Industries to young researchers, and of the 2015 - Ziegler-Natta Lectureship Award, by the German Chemical Society.

Understanding (and possibly solving) problems in catalysis, especially of industrial relevance, is Professor Cavallo's main activity. His interests span from homogeneous to heterogeneous catalysis. He is also active in the modeling of biological systems, with a focus on fundamental interactions stabilizing nucleic acid structures. His expertise in understanding the mechanics of catalysts at work involves him in several collaborations with colleagues around the world.

### Abstract

This presentation delves into the narrative of stereoselective 1-olefin polymerization, particularly focusing on the synthesis of isotactic polypropylene. A material that has revolutionized modern lifestyles since its discovery by the visionary Nobel laureate, Prof. Giulio Natta, at Politecnico di Milano in 1954. Starting from the pioneering modeling efforts of heterogeneous  $\text{TiCl}_3$  catalysts by Prof. Natta's collaborators, we progress to explore the modeling of stereoselective propene polymerization using homogeneous catalysts. The presentation will conclude with an example of the evolving landscape of modeling techniques, particularly emphasizing the potential dominance of machine learning in the near future.

# Catalysis

28<sup>th</sup> May 2024

## The Evolution of Industrial Stereoselective Olefin Polymerization catalysts. From $\text{TiCl}_3$ to modern $\text{MgCl}_2$ supported systems.

**Fabrizio Piemontesi**

Lyondellbasell, Centro Ricerche G. Natta, Ferrara



After the graduation in Chemistry at Università di Milano in 1987, and a post doc on the synthesis of late transition complexes for the oligomerization of olefins, in 1989 Fabrizio Piemontesi joined the group led by Prof. Umberto Giannini and dr. Enrico Albizzati in Guido Donegani Research Center (Himont, Novara). His first interest was on the synthesis and reactivity of Metallocene polymerization catalysts.

After moving on 1992 to Giulio Natta R&D Center (Himont, Ferrara) and continuing the researches on single site catalysts, he joined the Basell heterogeneous catalysis group in 2000.

The current role is Manager New Polyolefins in Ferrara Lyondellbasell Giulio Natta R&D Center and he is responsible for the advanced study of experimental ZN catalysts in the autoclave synthesis of propylene impact copolymers. Relationship among catalyst features and polymer properties is the main focus of his current research work.

He is co-author of about 50 peer reviewed papers and co-inventor of more than 40 patents.

### Abstract

Seventy years ago, in a laboratory of the Politecnico di Milano, an inorganic catalyst precursor made of titanium and chlorine, activated with an organometallic compound of aluminum, produced a completely new polymer of propylene: isotactic polypropylene.

The importance of this discovery, later worldwide recognized by the Nobel Price to Prof. Giulio Natta, was suddenly understood by Montecatini. Only 3 years after the discovery, an industrial polymerization plant started to produce the first isotactic polypropylene grade in Ferrara petrolchimico using a first development of Giulio Natta catalyst.

In this lecture, the evolution of the catalyst systems exploited industrially to produce polypropylene grades with increasing value and properties will be covered.

In particular, an industrial view on the discovery of  $\text{MgCl}_2$ , a non-innocent support for  $\text{TiCl}_4/\text{TiCl}_3$  catalytic sites, and the development introduced by the new ways to obtain  $\text{MgCl}_2$  spherical supports, together with the role of Lewis Bases in controlling the propylene insertion toward polymer chains with increasing degrees of regularity constitute the core of this lecture.

New developments on industrial catalysts for the production of polyolefins will be also discussed.

# Polymerisation

13<sup>th</sup> June 2024

## Sequencing Polypropylene

### Vincenzo Busico

Federico II University of Naples (Italy). Department of Chemical Sciences, Napoli



Prof. Vincenzo Busico is full professor of General and Inorganic Chemistry at the Federico II University of Naples (Italy), where he heads the Laboratory of Stereoselective Polymerizations (LSP). He also served as Professor of Polyolefin Chemistry at the Eindhoven University of Technology (Eindhoven, The Netherlands, 2007-2011), and Scientific Chairman of the Polyolefin Technology Area at the Dutch Polymer Institute (2004-2019).

His main scientific interests lie in catalytic olefin polymerization and polymer microstructure determinations. He is co-author of 200+ papers in international journals (WoS H-Index 51), 20+ international patents, and 50+ Plenary/Keynote lectures worldwide.

He is the recipient of the Chini Lecture Award (2024, Società Chimica Italiana), the Ziegler-Natta Lectureship Award (2009, Gesellschaft Deutscher Chemiker, GDCh), and the European Science and Engineering Award on '*Stereocontrol in Polymerization*' (1997, Exxon Chemical Europe).

### Abstract

When Giulio Natta «made polypropylene» in March 1954 it was hard to imagine that coordination catalysts would have been able to change a seemingly trivial (albeit prochiral) organic molecule into the chemical equivalent of an alphabet and competently encode complex information into a high molar mass hydrocarbon. The unprecedentedly wide properties envelope of what has become the largest-volume single plastic on the market stems from that ability. Similarly to DNA chains in the genome, polypropylene chains carry the code dictating the innate part of material behavior; on the other hand, sequencing polypropylene turned out to be -in chemical sense- much more challenging than DNA. In this talk I will tell how the Italian school of macromolecular stereochemistry, starting with the pioneering work of Annalaura Segre and Adolfo Zambelli, managed to 'break the code' and unraveled the relationships between high-resolution microstructure and physical properties.

# Polymerisation

13<sup>th</sup> June 2024

## Single centre catalysts for insertion polymerization. Opportunities, challenges, perspective

**Simona Losio**

Istituto di Scienze e Tecnologie Chimiche “Giulio Natta” (SCITEC-CNR), Milano



Simona Losio is a senior researcher at Istituto di Scienze e Tecnologie Chimiche “Giulio Natta” (SCITEC-CNR) in Milan (Italy).

Her research activity concerns the design, synthesis and characterization of ethylene and propylene based co- and terpolymers with higher, linear, cyclic, and branched olefins using homogeneous Ziegler-Natta catalysts and their  $^1\text{H}$  and  $^{13}\text{C}$  NMR characterization, often accompanied by the study of copolymerization statistics.

In recent years, her research has also focused on the synthesis of polymers from renewable sources, in particular polycarbonates and polyols from  $\text{CO}_2$ . Finally, she deals with the recovery and enhancement of sulfur for the preparation of innovative polymers for industrial applications.

### Abstract

In the last 40 years, thanks to the discovery of methylalumoxane (MAO) by Kaminsky, the interest in the homogeneous polymerization of polyolefins has not only grown, but has changed focus from primarily studying the metallocene complexes of Group 4 to widespread exploration of post-metallocene systems. Homogeneous catalysis has in fact proven to be a fantastic toolbox: it enables the synthesis of linear, branched, blocky or grafted (co)polymers, with tunable composition, branch-type distribution and stereosequences through the proper choice of the metal transition complex, mainly involving electronic and steric modifications of the ligand, (co)monomers, feeding methodology of (co)monomers and reactor operating conditions.



# Polymerisation

13<sup>th</sup> June 2024

## Stereospecific polymerisation of conjugated dienes: origins, developments and future prospects

**Giovanni Ricci**

Istituto di Scienze e Tecnologie Chimiche "Giulio Natta" (SCITEC-CNR), Milano



Dr. Giovanni Ricci graduated in Chemistry at the University of Parma in 1982 and he earned his Ph.D. in Chemical Science in 1987. In 1984 he was hired as researcher at the Istituto di Chimica delle Macromolecole (ICM) of CNR (the Institute created by Giulio Natta), directed at that time by Prof. Lido Porri of the Milan Polytechnic, and began to deal with stereospecific polymerization of conjugated diolefins with transition metal and lanthanide catalysts, which still represents his main interest. His current position is Research Director at the same institute, nowadays called Istituto di Scienze e Tecnologie Chimiche "Giulio Natta" (SCITEC "G. Natta").

In 2014 he was awarded with the *Recognition at Innovation eni "Eni Award"*, and in 2018 with the *Tire Manufacturing Innovation of the Year\_TTI Award*. He is co-author of 130 papers in international journals, 40 international patents and several communications to international meetings.

### Abstract

The presentation intends to provide an overview on the stereospecific polymerization of conjugated dienes (*i.e.*, butadiene, isoprene and substituted butadienes), from its origins in the 1950s at the Polytechnic of Milan to the present day, passing through the various developments that have concerned with the introduction of increasingly active and selective catalytic systems and the synthesis of new and more stereoregular polymeric structures.

Polybutadiene (*cis*-1,4 and syndiotactic 1,2) and *cis*-1,4 polyisoprene are currently the only polydienes industrially produced on a large scale: part of the lecture will therefore be dedicated to *i)* the description of the catalysts used for their synthesis; *ii)* their use, essentially for the production of elastomeric compounds for tires; *iii)* an overview on the worldwide major producers and users.

The final part of the presentation will focus on the future perspectives of the sector, mainly determined by the need for greater sustainability of industrial processes.

## Processes

19<sup>th</sup> September 2024

### CO<sub>2</sub> as Feedstock Processes for (Post-)Transition Era

#### Flavio Manenti

Politecnico di Milano. Dipartimento di Chimica, Materiali, Ingegneria Chimica



He is Full Professor of Chemical Plants at Politecnico di Milano, CMIC Dept. “Giulio Natta”, where he is the Director of the Centre for Sustainable Process Engineering Research and Coordinator of the Master of Science Degree in Food Engineering.

He has served for two terms the European Federation of Chemical Engineering (EFCE) as elected Charity Trustee (2016-2019). Currently, he is the President of the Computer Aided Process Engineering (CAPE), EFCE’s Working Party (based in London, UK), for the second term and Member of the Executive Board of worldwide Process Systems Engineering community (based in Houston, US).

He has been nominated in 2023 by the Minister On. Pichetto Fratin as Member of the Bio-Fuel Committee for the Ministry of Energy and Environment (MASE) for 4 years mandate.

He is the coordinator of Double PhD and MSc bilateral agreement with Institutions from all continents. He published more than 350 papers indexed by Scopus along with a series of 5 books titled “... for the Chemical Engineer” edited by Wiley-VCH (Weinheim, Germany) on process digitalization and chemical engineering.

Research consultant for national and international companies on Process and Process Systems Engineering, H<sub>2</sub> production and CO<sub>2</sub> Utilization with 28 filed patents and 6 trademarks. 6 technologies have been scaled up to TRL 9 in 2019-2024, with 9-16kt/y operating plants. Other 6 patents are at the industrial implementation phase with turnaround of investment for 42M€ in the last 5y.

For his research activities, he received international recognitions such as the “Excellence in Simulation” Award (Los Angeles, USA), the “Zdenec Burianec Memorial” Award (Prague, CZ), the “Alexander von Humboldt” Senior Research Award (Berlin, GER) and the Mashelkar Golden Medal (New Delhi, IN).

#### Abstract

The talk will illustrate existing and new trends for CO<sub>2</sub> utilization to progressively tackle sustainability in process industry.



## Processes

19<sup>th</sup> September 2024

### Industrial polymerization processes using Ziegler / Natta catalysts

**Paolo Vincenzi**

LyondellBasell, Centro Ricerche G. Natta, Ferrara



The professional experience of Paolo Vincenzi at Research Centre “Giulio Natta” in Ferrara started in 1988, just after Chemical Engineering graduation at the University of Bologna. He had the great opportunity to be part of the Research and Development team led by Ing. Gabriele Govoni, experiencing the advantages of timely and flexible organization at pilot plant facilities.

During first twelve years he contributed in different roles to the development of polymerization processes, like *Spheripol*, *Catalloy*, *Spherilene*, Aliphatic Poly-ketone, *Spherizone*, Polybutene-1.

The last twenty-four years have been dedicated to process development and industrialization of innovative Z/N catalysts and their manufacturing technologies.

The focus of interest has consistently been on the improvement of production processes with the objective of obtaining products with competitive advantages.

#### Abstract

An overview of polymerization processes is here presented, analysing the synergy among catalyst properties, polymerization technologies and final product.

The presentation deals with the heterogeneous catalysts, focussing the attention to their physical shape and structure, replicated in the polymeric growing particle. Moreover, a wider range of product performance is made available by continuous research on chemical composition.

The development of various type of reactors follows the objective to exploit the potentiality of available catalyst systems. On the other hand, the physical properties and the chemical composition of a catalyst system are designed to be suitable for a specific reaction technology, to allow the production of a defined family of polymeric materials. The evolution of polymerization technology is described with some specific examples, from the very beginning up to recent development.

# Materials

10<sup>th</sup> October 2024

## The impact of Natta's discoveries on industry and everyday life

**Gaetano Guerra**

Università di Salerno



Gaetano Guerra is Emeritus Professor of Industrial Chemistry of University of Salerno. All his scientific activity was devoted to theoretical and experimental studies relative to polymeric materials. A large part of his research activity has been devoted to the study of structure-property relationships for semicrystalline polymers of industrial relevance. This research activity is documented by more than 370 scientific papers on international journals as well as by many industrial patents and chapters of books.

Prof. Guerra was President of the Italian Association of Macromolecular Science and Technology (AIM) and President of Società Chimica Italiana (SCI), from January 2020 to December 2022. From November 2017 he is a member of the Accademia Nazionale dei Lincei and he was member of the Expert Group of the European Academies Science Advisory Council (EASAC) for the Policy Report 39 on “Packaging plastics in the circular economy”.

### Abstract

The main objective of the seminar is to describe the significant impact of the discoveries of Natta and his School (which led to the 1963 Nobel Prize in Chemistry) on the polymer industry and more generally on the manufacturing industry globally.

A large part of this contribution is addressed to isotactic polypropylene (i-PP), which is currently the polymer of largest industrial production. The great and lasting impact of Natta's discoveries on the rubber industry will also be shown.

The final part of the seminar will also discuss polyacetylene, a polymer much less well known to the uninitiated, which was first synthesised in 1958 in Natta's laboratories. Important research into the electrical conductivity of this polymer led to Heeger, MacDiarmid and Shirakawa being awarded the 2000 Nobel Prize in Chemistry.

# Materials

10<sup>th</sup> October 2024

## Polypropylene: A Pillar of the Global Manufacturing Industry

### Claudio Cavalieri

Lyondellbasell, Centro Ricerche G. Natta, Ferrara



Claudio Cavalieri graduated in Chemistry from Milan State University in 1998 and currently works in the Polypropylene Research and Development department of Lyondellbasell in Ferrara.

He started at Targor Italia in 2000 covering over the years various roles and responsibilities mainly in the field of product development and applications for Polyolefins. He also gained international experience in Germany (at Targor GmbH in Ludwigshafen) and in America (at Lyondellbasell in Cincinnati OHIO) always as product development group manager.

Since 2022 he has been leading and coordinating the Advancing Portfolio and Circular Design Polypropylene Group for the development of new products and new, more sustainable solutions to offer our customers that also include the use of recycled materials.

He is the author and co-author of a hundred product and application patents.

### Abstract

The main objective of the talk is to describe the impact today of Giulio Natta's discoveries and in particular of polypropylene on the manufacturing industry at a global level. This will be done by emphasising the importance of the properties of these materials through application examples in important market segments, such as automotive, packaging, medical, etc.

Examples will be given of how recent global megatrends are calling upon polyolefins to respond more and more rapidly to the different demands of consumers and industry.

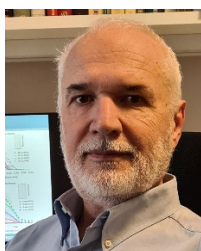
# Circularity

15<sup>th</sup> November 2024

## New perspectives for thermal recycling of plastics

### Tiziano Faravelli

Politecnico di Milano. Dipartimento di Chimica, Materiali, Ingegneria Chimica



Tiziano Faravelli is professor of Chemical Engineering at Politecnico di Milano. He is the senior member of the CRECK modeling group. His activity focuses mainly on the engineering of chemical reactions of complex systems. In particular he has developed detailed kinetic models of pyrolysis, partial oxidation and combustion of gases, liquid and solid fuels, both fossil and renewable. Recently he has been working on modeling thermal processes for recycling various wastes, such as plastic and biomass. To this end he is working on physical aspects at different scales (from nano, to micro, to meso, up to industrial scale), such as the fluid dynamics of these reacting flows, including both homogeneous and heterogeneous processes.

He was an Associate Editor of the Proceedings of the Combustion Institute and currently serves as an associate editor of Combustion and Flame. He is fellow of the Combustion Institute and Mercator Fellow of the Technical University of Darmstadt.

His research has led to 290 refereed journal or book publications and 3 co-edited books (Scopus citation data: total citations > 15000, H-index = 65).

### Abstract

One of the key paradigms of the new economy is circularity. This must be applied in particular to sectors with the highest environmental impact, such as plastics. Among the various recycling routes, thermal recycling offers a number of advantages and some disadvantages. The conference will demonstrate how recent research in fluid dynamics and the kinetics of pyrolysis and gasification processes is paving the way for the development of more efficient and environmentally friendly equipment.

In particular, the conference will discuss and analyse recent developments in the understanding of the chemical-physical phenomena underlying the thermal degradation of polymers, with particular reference to waste, which is intrinsically very complex. It will also examine how this research has produced detailed and reliable models, ready for transfer to the industrial field.

# Circularity

15<sup>th</sup> November 2024

## Circular Plastic: Analysis, Perspectives and Initiatives for Sustainability

### Vincenzo Lumia

PlasticEurope Italia- Federchimica



Vincenzo Lumia is the Director both of PlasticEurope Italia and Assobase, the Associations of Federchimica representing the Italian plastic materials and base chemicals Producers.

Vincenzo Lumia is graduated in Management at Bocconi University, and he achieved an MBA in 2017.

His professional background was formed at business. He trained as strategic consultant and then he moved to the petrochemical sector, engaged at the main Oil-Chemical Italian Company, where he spent 18 years, with commitments as manager at an international level in: strategy definition, corporate and organizational transformations, marketing intelligence, business process management and change management.

He has begun his experience in Federchimica in 2023, as Technical Regulatory Manager at the same Associations of which he is Director since February 2024.

### Abstract

The plastic 'question' is a vast subject, of which the issue of circularity plays a central role. Dealing with this topic is only possible by keeping in mind how pervasive plastics are in our lives and how articulated is the related framework of interacting interests, actors, systems and rules.

Some quantitative background elements will be provided and we will then move on to analyse the life cycle of plastics, with particular reference to the post-use phases, i.e. from waste to waste management options.

In this context, the issue of end-of-waste will be particularly relevant, i.e. the "moment" in the plastics cycle when a waste ceases to be a waste, through recovery procedures, and acquires the status of raw material/product.

The possible alternatives available to society in the current legislative and technological scenario for greater sustainability and circularity of plastics will then be briefly described.

The talk will conclude with a brief outline of current initiatives by the industry at both national and European level and the circularity and sustainability targets that the sector aims to achieve.

# Circularity

15<sup>th</sup> November 2024

## Polyolefins and the Circular Economy: Features, Recycling and Innovations

**Stefano Turri**

Politecnico di Milano. Dipartimento di Chimica, Materiali, Ingegneria Chimica



Stefano Turri, who began his industrial career at a company within the Montedison group, is now a full professor of materials science and technology at the Politecnico di Milano. He has also served as coordinator of the degree course in materials engineering and nanotechnology at the university from 2017 to 2022.

His current research interests include the recycling technologies of polymeric and composite materials, the development and characterisation of polymers from renewable sources, the study of smart and stimuli-responsive polymers for functional applications, and the science and technology of surfaces and interfaces.

His research has resulted in over 200 scientific articles published in international peer-reviewed journals, two books, and more than 20 industrial patents already extended internationally.

### **Abstract**

Polyolefins, such as polyethylene and polypropylene, represent bulk polymers with a significant impact on modern society, including considerations related to the circular economy.

This seminar will address the structural characteristics and degradation behaviour of these materials, with a focus on their implications for recognition and physical recyclability, both through mechanical technologies and innovative solvent-based methods.

The chemical processes for transforming polyolefins into vitrimeric polymers through functionalisation with dynamic and reversible cross-linking sites will then be described, highlighting their innovative character and positive impact in terms of recyclability of the material at the end of its life.



# Circularity

15<sup>th</sup> November 2024

## Digital Solutions for Polyolefin Recycling and Upcycling

### Marinella Levi

Politecnico di Milano. Dipartimento di Chimica, Materiali, Ingegneria Chimica



Marinella Levi is Professor of Materials Science and Technology, and Director of the Department of Chemistry, Materials and Chemical Engineering 'Giulio Natta' at Politecnico di Milano.

Her current research interests are mainly focused on the research for new advanced polymeric and composite materials for the development of 3D and 4D printing technologies, for applications ranging from health to electronics, from design to circular economy.

Marinella Levi is author or co-author of more than 180 papers published on peer-reviewed international scientific journals that received more than 5000 citations. Moreover, she authored 11 patents, and 7 books about the relationship between Materials Engineering and Product Design.

### Abstract

The topic of circularity, particularly when applied to the context of plastics, can be read and analyzed from several points of view. This seminar will illustrate the possibility of addressing some of the peculiarities of recycling and the creation of circular processes, for polypropylene and polyolefins in general, both using digital technologies.

In the first part, the possibility of using 3D printing technologies with a focus on upcycling, and with an application-driven approach for the recycling and valorization of waste and scrap from, for example, personal protective equipment made of non-woven textiles widely used in, for example, the medical sector, electronics, and the food processing industry, will be illustrated.

The opportunity to use artificial intelligence and machine learning as important drivers for overcoming some critical issues related to the mechanical recycling of polyolefins, e.g. related to recognition, and with the separation of polypropylene and polyolefins, in general, will be considered.