

## CURRICULUM VITAE OF EMANUELA LICANDRO

### Personal and Anagraphical Data

- Name and surname : EMANUELA LICANDRO
- resident in Milano (Italy)
- born in Milano (Italy), date 11/08/1952
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### Titles

- Laurea in Chemistry at Università degli Studi di Milano (UNIMI), Italy, 1977
- Fellowship of the Chemical Industry EUTECO-ENICHEM 1977-79
- Fellowship of the Università degli Studi di Milano, 1979-81
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### Actual Academic Position And Previous Positions

Actual position: Full Professor since 2000 at UNIMI, Department of Chemistry

### Previous Positions

- Permanent position as Researcher in Organic Chemistry at UNIMI, 1980-1992
- Associate Professor in organic chemistry at Department of Organic and Industrial Chemistry of UNIMI, 1992-2000.
- other post-doc positions: (i) Period at the Imperial College of Science, Medicine and Technology of London, laboratory of prof. Steven Ley, 1988-1989.
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### Funding ID (actually open)

National project PRIN 2009, prot. 20093N774P. *Title*: "Molecular recognition of micro-RNA (miR) by modified PNA: from structure to activity". 2011-2013

National project CARIPO FOUNDATION, "Call 2011 - Promuovere progetti di ricerca finalizzati allo studio dell'impatto del particolato ultrafine e delle nanoparticelle ingegnerizzate sulla salute dell'uomo. *Title*: "Inter-cellular delivery, trafficking, and toxicity of engineered magnetic nanoparticles in macrophages and CNS cells". 2012-2015. National project CARIPO FOUNDATION, "Call 2013 – Ricerca Scientifica e Tecnologica sui Materiali Avanzati. *Title*. "New biomimetic tools for miRNA targeting" (BaTMAN)

### Application to European research projects

2013: Proposals ERC-2013-SyG- Synergy Grant - Proposal n° 610034: "Chemically modified PNA as anti miRNAs: from structure to "in vivo" activity" (CoMPARSA) was retained following the pre-screening step 1 based on the extended synopsis and the Principal Investigators' track records and CVs.

### **PANEL SCORE AND RANKING RANGE**

**Final panel score** : B (meets some but not all elements of the ERC's excellence criterion and will not be funded)

Ranking range \*: 14%-18% (\* Ranking range of your proposal out of the proposals evaluated by the panel, in percent, from 1% for the highest ranked proposals to 100% for the lowest ranked.)

### Other Funded Research Projects

**1991** : Progetto Finalizzato Chimica Fine II, "New synthesis of products with biological activity"

**1994** : European Research Programme "Human Capital and Mobility Network", "Multiple Metal-Carbon Bond Species in Selective Processes".

**2001** : European programme COST D14. "Photorefraction with organometallic dipoles in helical environments".

**1995-2001**: European Programme COST D1/D8, "New Applications of Organometallic Compounds in Bioinorganic and Organic Chemistry". **1996**: FIRB 2003 – RBNE033KMA, "Molecular compounds and hybrid nanostructured materials with resonant and non resonant optical properties for photonic devices". **1999-2001**:

collaboration with GlaxoWellcome Company of Verona, "Arenechromiumtricarbonyl derivatives supported on solid phase: preparations and reactivity", and "Metal-mediated synthesis on solid phase: preparation of supported new Fischer-type carbene complexes and their utilization for the solid phase synthesis". **2001**: National Project COFIN, "Stereoselection in Organic Synthesis. Methodologies and Applications". National Project FIRB; "Innovative molecules with antiflogistic and antitumoral activity synthesised with advanced

methodologies". **2005-2007**: national project PRIN 2005, "Design, synthesis and biomolecular properties of peptide nucleic acids (PNA) and their analogs for diagnostic and therapeutic applications". **2005-2008**: national project FIRB 2003: "Molecular compounds and hybrid nanostructured materials with resonant and non resonant optical properties for photonic devices". **2008**: project PRISMA 2007: "Porfirine simmetricamente e asimmetricamente sostituite per applicazioni nelle celle solari e nella limitazione ottica". **2009**: FONDAZIONE CARIPLO: "Studio del ruolo dei metalli nella progettazione e utilizzo di nuovi materiali per celle solari organiche di terza generazione". **2011-2013**: collaboration with ENI Donegani of Novara: "Materiali organici, molecolari e polimerici per l'impiego in celle solari ibride (DSSCs), in celle organiche (BHJ) e in concentratori solari".

#### **Organization of scientific meetings and Schools**

**1993-present**: Member of the scientific board for the Ph.D. School in Chemical Science, of UNIMI. **1995-1998**: Organizing Committee of the Summer School "A. Corbella, Seminar in Organic Synthesis". **1996**: Organizing committee of **RSCI-Joint Meeting on Heterocyclic Chemistry**, Numana (Italy). **2005-2007**: Organizing committee of **ICOS 12, 12<sup>th</sup> International Conference on Organic Synthesis**, Venezia. **2005-2007**: Chairman of the "Attilio Corbella" Summer School: "Seminars in Organic Synthesis". **2006**: Organizing committee of **ISBOMC'06, 3<sup>rd</sup> International Symposium on Bioorganometallic Chemistry**, Milan. **2011-2012**: Organization of the **X Co.G.I.C.O., Congresso Interdivisionale del Gruppo di Chimica Organometallica**, Padova, and VIII and IX editions of International School of Organometallic Chemistry (ISOC 8, 2011, and ISOC 9, 2013), Camerino, Italy. **2012**: Coordinator of the Ph.D. course in Chemical Sciences of UNIMI. **2014**: Chairman of the **XI Congress of the Interdivisional Group of Organometallic Chemistry (XI Co.G.I.C.O.)** of the Italian Chemical Society, University of Milan, 24-27 June, 2014, Milan.

#### **Invited Conferences and Periods Abroad as Visiting Professor**

**1989-2014**: About twenty invited conferences in national and international congresses/meetings/seminars. Visiting professors in February 2000 (one month) and February 2010 (one month) at Université Pierre et Marie Curie, Paris VI and Ecole Nationale Supérieure de Chimie de Paris.

#### **Teaching Activity and Lectures at Specialization Schools**

Teacher of three-four courses per year for Laurea courses in Biology, Chemistry, Industrial Chemistry in fundamental courses (Organic Chemistry II, Laboratory of Organic Chemistry) and advanced courses (Laboratory of Applied Organic Chemistry, Concepts and Methodologies of Organic Synthesis (in English), Introduction to Nanotechnology, Chemistry of Heterocyclic Compounds). Tutor and/or co-tutor of several undergraduation and Ph.D. theses, and post-doc fellowships. Several lectures and seminars within Italian and foreign PhD Schools, Masters courses, training courses for Pharmaceutical Companies.

#### **Scientific Interests**

**Author of about 140 publications on international Journals with referees and 9 patents.**

Synthesis and reactivity of heterocyclic compounds. Use of arenechromium tricarbonyl complexes and Fischer-type carbene complexes for the stereoselective formation of new carbon-carbon bonds and polymer-bound organometallics for solid phase synthesis and application of transition metal complexes chemistry to biomolecules. Design and synthesis of PNAs with new structural characteristics, to obtain modified PNAs for diagnostics and as anti-sense agents. Design and synthesis of new functionalized thia-[7]-heterohelicenes prepared by innovative methodologies and submitted to NLO measurements. Some recent results related to the set up of new methodologies for the synthesis and functionalization of tetrathiahelicenes have been mentioned in *Aldrichimica Acta*, ACTA Forum, Vol. 38, No. 2, 2005; in *Synfacts*, **2007**, 1, 0038-0038; in *Cheminform*, **2007**, vol. 38, issue 10.

#### **Patents**

1) Derivati alchilamminoalchilnaftalenici ad attività farmacologia. Patent No. 1.213.219, Ital. Appl. 14/12/1989. 2) Aminoalkylnaphtalene derivatives having pharmacological activity. Patent No. 0.176.049, Ital. Appl. 13/06/1990. 3) Derivati cicloalchilamminoalchilnaftalenici ad attività farmacologia. Patent No. 1.196.273, Ital. Appl. 16/11/1988. 4) Procedimento per la preparazione dell'acido 2,2-dimetil-5-(2,5-dimetilfenossi)valerianico. Patent No. 1.196.273, Ital. Appl. 16/11/1988. 5) Synthesis of hydrazines and hydrazides by reduction of hydrazones and azines. Patent No. MI2000A000292, Ital. Appl. (2001), 22 pp. 6) Nuovo metodo di arilazione di idrazine. Patent No. MI2002A002771, Ital. Appl. (2001). 7) "Fotosensibilizzatori porfirinici push-pull per celle solari DSSC. 8) Domanda N. MI2011A000184, 08 Febbraio

2011, "Composti Fotosensibilizzanti Metal Free". 9) Composti fotoluminescenti o miscela di composti fotoluminescenti per convertitori di spettro" Patent disclosure nr. H10069.

### **National and international recent collaborations**

Université Pierre et Marie Curie, Paris VI; University of Heidelberg; Institut de Chimie des Substances Naturelles, CNRS, Gif-sur-Yvette; University of Norwich; University of Torino; IIT Genova; IIT Politecnico di Milano; University of Perugia; University of Modena; Cancer Institute of Milan; University of Padova, University of Parma. Institut de Science et d'Ingénierie Supramoléculaires (I.S.I.S.), Université de Strasbourg. Istituto di Tecnologia Biomediche, CNR, Segrate, Milan, Italy. Institute of Physical Chemistry, Polish Academy of Sciences. Warsaw, Poland. Instituto de Investigaciones Químicas, CSIC. Seville, Spain.

## **EMANUELA LICANDRO - TRACK RECORD**

### **18 Representative Publications as Senior Author (Jan.2007-Jan. 2013)**

The list is composed by 6 selected most recent publications in the field of peptide nucleic acids (PNA), modified both with organometallic complexes or magnetic nanoparticles and 12 most recent representative papers of the research activity in the field of helicenes. Citations are also shown (Scopus source). In all the listed publications E. L. is the senior author of the research group; in case of joint papers with other research groups the last author of the paper may result different from E. L. because of a different agreement reached among co-authors.

In the reported 6 paper in the field of PNA, a significative and innovative contribution has been done to the field of bioorganometallic chemistry, establishing that metal-modified PNA maintain their biological behavior, being able to recognize and hybridize complementary sequences of DNA single strands. In particular, new luminescent bioconjugates between rhenium(I) complexes and PNA have shown to give easy uptake in some cell lines.

The expertise in this field has been internationally recognized through the invitation to contribute with a paper to the special issue of Organometallics dedicated to Biology and Medicine and with a chapter to the Wiley\_VCH book "Bioorganometallic Chemistry-Applications in drug Discovery, Biocatalysis, and Imaging" edit by G. Jaouen and M. Salmain, title of the contribution: "Organometallic Bioprobes for cellular Imaging". (Submitted)

In addition, for the first time PNA have been conjugated to magnetic nanoparticles leading to new, stable magnetic PNA still able to recognize and hybridize complementary DNA. The hybridization event could be revealed by the variation of T2 value in the magnetic hybrid with complementary DNA.

The 12 selected publications in the field of heterohelicenes as polycyclic heteroaromatic fully conjugated chiral systems span from the set up of innovative ways to build up the helical skeleton (which brought to a citation in Synfacts and Aldrichimica Acta of the corresponding paper), to innovative applications of these helical systems in non linear optics, organometallic stereoselective homogeneous catalysis and organocatalysis, till the applications in photovoltaics. In the context of this research, the first non-photochemical synthesis of the benzodithiophene (BDT) scaffold, which is the key intermediate for the synthesis of helicenes and polymers for photovoltaics, has been reported. This new strategy open the way to scale up the synthesis of BDT itself and its derivatives, helicenes included.

Moreover, a systematic and extended theoretical, synthetic and electrochemical study on helicene phosphanes, as new chiral ligands for homogeneous catalysis and organocatalysis, has been published. Recently, within this research, the first organometallic gold complex of a helical phosphane has been described.

1. "A Novel and efficient Approach to (Z)-1,2-Bis(benzodithienyl)ethene precursors of Tetrathia[7]helicenes", C. Baldoli, A. Bossi, C. Giannini, E. Licandro, S. Maiorana, D. Perdicchia, Synlett, 1137, (2005). Citations: 17 (total 28) This paper has been reported by Synfacts, 2007,1,0038.
2. "Synthesis of hydrazine-peptide nucleic acid monomers and dimers as new PNA backbone building blocks", P. Cerea, C. Giannini, S. Dall'Angelo, E. Licandro, S. Maiorana, M. Rosangela, Tetrahedron, 63, 4108 (2007). Citations: 2 (total 4)

3. "Silyl Substituted Tetrathia[7]helicenes: Synthesis, X-Ray Characterization and Reactivity",  
A. Bossi, S. Maiorana, C. Graiff, A. Tiripicchio, E. Licandro, *Eur.J.O.C.*, 4499, (2007). Citations: 15 (total 22)  
**COVER PAGE**
4. "Novel Substituted Tetrathia[7]Helicenes By Direct Functionalization of the Helical System or Photocyclization of Substituted 1,2-(Bis-Benzodithienyl)Ethenes",  
C. Rigamonti, M. T. Ticozzelli, A. Bossi, E. Licandro, C. Giannini, S. Maiorana, *Heterocycles*, 76, 1439, (2008). Citations: 2 (total 5)
5. "Theoretical and Experimental Investigation of Electric Field Induced Second Harmonic Generation in Tetrathia[7]helicenes."  
Bossi, Alberto; Licandro, Emanuela; Maiorana, Stefano; Rigamonti, Clara; Righetto, Stefania; Stephenson, G. Richard; Spassova, Milena; Botek, Edith; Champagne, Benoit.  
*Journal of Physical Chemistry C* 2008, 112(21), 7900-7907. Citations 50.
6. "Synthesis, Characterization, and Transistor Response of Tetrathia-[7]-Helicene Precursors and Derivatives"  
Choongik Kim, Tobin J. Marks, Antonio Facchetti, Michele Schiavo, Alberto Bossi, Stefano Maiorana, Emanuela Licandro, Francesco Todescato, Stefano Toffanin, Michele Muccini, Claudia Graiff and Antonio Tiripicchio  
*Organic Electronics*, 2009, 10, 1511–1520. Citations 20.
7. "Magnetic Peptide Nucleic Acids for DNA targeting",  
G. Prencipe, S. Maiorana, P. Verderio, M. Colombo, P. Fermo, E. Caneva, D. Prosperi and E. Licandro, *Chem. Commun*, 6017 (2009). Citations: 6
8. "Electrochemical activity of thiahelicenes: structure effects and electrooligomerization ability  
Alberto Bossi, Luigi Falciola, Claudia Graiff, Stefano Maiorana, Clara Rigamonti, Antonio Tiripicchio, Emanuela Licandro, Patrizia Romana Mussini"  
*Electrochimica Acta*, 2009, 54, 5083-5097. Citations 17.
9. "Fluorescent Conjugates Between Dinuclear Rhenium(I) Complexes and Peptide Nucleic Acids (PNA) for Cell Imaging and DNA Targeting"  
E. Ferri, D. Donghi, M. Panigati, G. Prencipe, L. D'Alfonso, I. Zanoni, C. Baldoli, S. Maiorana, G. D'Alfonso, and E. Licandro, *Chem. Commun*, 46, 6255, (2010). Citations: 30
10. "Tetrathiaheterohelicene Phosphanes as Helical Shaped Chiral Ligands for Catalysis"  
M. Monteforte, S. Cauteruccio, S. Maiorana, T. Benincori, A. Forni, L. Raimondi, C. Graiff, A. Tiripicchio, G. R. Stephenson and E. Licandro, *Eur.J.O.C.* 5649, (2011). Citations: 15
11. "Peptide Nucleic Acids tagged with four lysine residues for amperometric genosensors"  
C. Zanardi, F. Terzi, R. Seeber, C. Baldoli, E. Licandro, S. Maiorana, *Artificial DNA, PNA & XNA*, 3, 80 (2012). Citations: 1
12. "Metal-free Benzodithiophene-containing Organic Dyes for Dye Sensitized Solar Cells  
E. Longhi, A. Bossi, G. Di Carlo, S. Maiorana, F. De Angelis, P. Salvatori, A. Petrozza, M. Binda, V. Roiati, P. R. Mussini, C. Baldoli, E. Licandro, *EurJOC*, 84, (2012). Citations: 5
13. "Luminescent conjugates between dinuclear rhenium complexes and peptide nucleic acids (PNA): synthesis, photophysical characterization, and cell uptake"  
C. Mari, M. Panigati, L. D'Alfonso, I. Zanoni, D. Donghi, L. Sironi, M. Collini, S. Maiorana, C. Baldoli, G. D'Alfonso, and E. Licandro, *Organometallics*, 31, 5918, (2012). Citations: 5

14. "Tetrathia[7]helicene-Based Complexes of Ferrocene and (η<sup>5</sup>-Cyclohexadienyl)Mn(CO)<sub>3</sub> : Synthesis and Electrochemical Studies"  
Ming Li, Françoise Rose-Munch, Eric Rose, Jean Claude Daran, Alberto Bossi, Emanuela Licandro, Patrizia Romana Mussini  
Organometallics, 2012, 31(1), 92-104. Citations 8.
- 14 "Gold(I) Complexes of Tetrathiaheterohelicene Phosphanes"  
Silvia Cauteruccio, Annette Loos, Alberto Bossi, Maria Camila Blanco Jaimes, Davide Dova, Frank Rominger, Stefan Prager, Andreas Dreuw, Emanuela Licandro, A. Stephen K. Hashmi  
Inorg. Chem., 2013, 52, 7995–8004. doi.org/10.1021/ic4005533 |
- 15 "Synthesis, Photophysics and Electrochemistry of Tetra(2-thienyl)ethylene (TTE) Derivatives"  
Bolzoni, A.; Viglianti, L.; Bossi, A.; Mussini, P. R.; Cauteruccio, S.; Baldoli, C.; Licandro, E.  
Eur. J. Org. Chem. 2013, 7489. DOI: 10.1002/ejoc.201300745. **COVER PAGE**
- 16 "Magnetic Iron Oxide Nanoparticles Functionalization: Isocyanate Moiety as a suitable Monodentate Anchoring Group"  
Carrara, C.; Sala, M. C.; Caneva, E.; Cauteruccio, S.; Licandro, E. Org. Lett. 2014, 16, 460. DOI: 10.1021/ol4033489.
- 17 "Non-Photochemical Route to Simple Benzo[1,2-b:4,3-b']dithiophenes: FeCl<sub>3</sub>-mediated Cyclization of Dithienyl Ethenes"  
Cauteruccio, S.; Dova, D.; Graiff, C.; Carrara, C.; Doulcet, J.; Stephenson, G. R.; Licandro, E.  
New J. Chem., 2014, doi:10.1039/C3NJ01567J.
- 18 "Synthesis, Characterization and Organocatalytic Activity of Chiral Tetrathiahelicene Diphosphine Oxides"  
Cauteruccio, S.; Dova, D.; Benaglia, M.; Genoni, A.; Orlandi, M.; Licandro, E. Eur. J. Org. Chem. 2014, in press.

### **Book Chapter**

Contribution to a chapter of the book: "Bioorganometallic Chemistry-Applications in drug Discovery, Biocatalysis, and Imaging" edit by G. Jaouen and M. Salmain, title of the contribution: "Organometallic Bioprobes for cellular Imaging". (Submitted)

### **Patents**

1) Derivati alchilamminoalchilnaftalenici ad attività farmacologia. Patent No. 1.213.219, Ital. Appl. 14/12/1989. 2. Aminoalkyl naphthalene derivatives having pharmacological activity. 2) Patent No. 0.176.049, Ital. Appl. 13/06/1990. 3) Derivati cicloalchilamminoalchilnaftalenici ad attività farmacologia. Patent No. 1.196.273, Ital. Appl. 16/11/1988. 4) Procedimento per la preparazione dell'acido 2,2-dimetil-5-(2,5-dimetilfenossi)valerianico. Patent No. 1.196.273, Ital. Appl. 16/11/1988. 5) Synthesis of hydrazines and hydrazides by reduction of hydrazones and azines. Patent No. MI2000A000292, Ital. Appl. (2001), 22 pp. 6) Nuovo metodo di arilazione di idrazine. Patent No. MI2002A002771, Ital. Appl. (2001). 7) "Fotosensibilizzatori porfirinici push-pull per celle solari DSSC. 8) Domanda N. MI2011A000184, 08 Febbraio 2011, "Composti Fotosensibilizzanti Metal Free". 9) Composti fotoluminescenti o miscela di composti fotoluminescenti per convertitori di spettro" Patent disclosure nr. H10069.

### **Invited Presentations**

Several presentations at national/international conferences/workshops/schools/meetings.

The most representative invited talks:

- 1) Concord Gecom 2002, Université Pierre et Marie Curie, Paris VI, "Fischer-type carbene complexes: still efficient and versatile organometallic tools for organic synthesis".
- 2) University of Amsterdam, Prof. Dr. C. J. Elsevier, "The hydrazine-stabilized metalcarbonyl carbenes: a new class of Fischer-type carbene complexes and their potential for organic synthesis". Amsterdam 2002.

- 3) IVth French-Italian Meeting on Organic Chemistry (FIMOC IV), Annecy 2004, "Novel functionalized heterohelicenes: new synthetic routes and applications".
- 4) SISOC VII. University of Oviedo, 2008, Spain. "Novel functionalized heterohelicenes: new synthetic routes and applications".
- 5) Université Pierre et Marie Curie, Paris VI, Paris 2010, Seminaires de Chimie Organique, "Modified peptide nucleic acids (PNA) for DNA targeting".
- 6) Lesson for Ph.D. students at the Université Pierre et Marie Curie, Paris VI, Paris, 2010, "Fluorous protecting groups: a new tool for organic synthesis".
- 7) Lecture at Department of Inorganic Chemistry (ACI), University of Zürich, 2013, "Synergistic cooperation of organic and inorganic fragments: the case of metal-modified peptide nucleic acids".
- 8) Invited for a Lecture at "RSC-SCI Joint Meeting on Heterocyclic Chemistry", London, July 2014.

#### **Organisation of International Conferences**

I have contributed/I'm contributing to the organization of the following International conference/Schools

- 1) Member of the organizing committee of ISBOMC'06, 3rd International Symposium on Bioorganometallic Chemistry, Milan, 2006
- 2) 8<sup>th</sup> ISOC, International School of Organometallic Chemistry, Camerino, 2011
- 3) 10<sup>th</sup> ISOC, International School of Organometallic Chemistry, Camerino, 2013

#### **Memberships of Editorials Boards of International Journals**

**2000-2011:** Member of the Excellence Centre of the University of Milan "*Centre for Bio-molecular Interdisciplinary Studies and industrial Applications [CISI]*". **2010-present:** Member Editorial board of International Journal of Organic Chemistry (IJOC).

#### **Examples of Leadership in Industrial Innovation or Design**

2011-2014: Scientific responsible of a collaboration between the University of Milan and the ENI Donegani research institute in Novara. The role of the group is the design and synthesis of innovative molecular systems for potential applications in photovoltaics or for solar concentrators. This collaboration is an interesting and useful balance between basic and applied research, based on the synergistic cooperation between academy and industry researchers. Between 1999-2001 scientific responsible of a collaboration between the University of Milan and the GlaxoWellcome Company of Verona, title of the research: "Arenechromiumtricarbonyl derivatives supported on solid phase: preparations and reactivity". Participation to another contract between the University of Milan and the GlaxoWellcome Company of Verona, title of the research: "Metal-mediated synthesis on solid phase: preparation of supported new Fischer-type carbene complexes and their utilization for the solid phase synthesis."