

## ELECTROSPUN FIBRES: BUILDING BLOCKS FOR INNOVATIVE MATERIALS

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Exploitation of electrostatic forces for spinning fibres is not a new approach, since it has been known for more than one hundred years. The recent interest in nanotechnology has brought to a rediscovery of the electrospinning technique, due to its capability of yielding fibres in the submicron range. Mainly because of this reason, electrospun nanofibres attracted a huge interest in the research community, as testified by the ever increasing scientific literature on the subject. Most of these reports are focused on the use of nanofibres in fields such as nanocatalysis, tissue scaffolds, protective clothing, filtration, and optical electronics.

In this talk, two uncommon applications of electrospun will be described.

In the first part, the use of such fibres as fillers in polymer-based composites will be discussed. It was found that the presence of fibers modified the semicrystalline framework of the matrix and allowed to improve the tensile properties of the material. Moreover, electrospun fibers allowed to tune the degradation rate of the composite: this could be accelerated or slowed down as a function of the degree of interfacial adhesion between the matrix and filler. These examples will be presented.

The second part will be about hydrogels. These are polymeric materials which, albeit not soluble in water at physiological pH and temperature, are considerably hydrophilic and can absorb relevant volumes of water, with substantial swelling ratios. Such feature makes these materials very interesting and important in the field of drug delivery, because they are compatible with biological tissues, they are easy to manipulate in the swollen state and they are very permeable to solutes. Usually the preparation of gels happens through a sol-gel mechanism, in which the precursors of the gels in monomeric or oligomeric form are gradually crosslinked by physical or chemical means. If this allows a control on a molecular scale, on the other hand it allows less control on a larger scale. In this work, we show gels prepared starting from electrospun fibres, i.e. with a morphology controlled on a scale of the nanometres-micrometres. Examples of pH- and temperature-responsive materials will be presented.

### **References**

1. Neppalli R., Marega C., Marigo A., Bajgai M.P., Kim H.Y., Causin V. *European Polymer Journal* **46** (2010) 968
2. Neppalli R., Marega C., Marigo A., Bajgai M.P., Kim H.Y., Causin, V. *Polymer* **52** (2011) 4054
3. Neppalli R., Causin V., Marega C., Marigo A., Bajgai M.P., Kim, H.Y., Ray S.S. *Journal of Materials Research*, **27** (2012) 1399



## Curriculum Vitae et Studiorum Valerio Causin

Valerio Causin

Born in Venice, Italy, on March 14<sup>th</sup>, 1975

Home address: via Grazioli 29, 30174 Venice (Italy)

Affiliation: Dipartimento di Scienze Chimiche, Università di Padova, via Marzolo 1,  
35131 Padova, Italy

### EDUCATION:

- 2004 Ph.D., Chemical Sciences. University of Padova. Dissertation: Forensic Characterization of Textile Fibers.  
Dissertation Co-Chairs: Prof. Antonio Marigo, Prof. Maurizio Casarin
- 2000 B.Sc., *Magna cum Laude*, Industrial Chemistry. University of Padova.  
Thesis: Role of microstructure and temperature on the crystallization behaviour of isotactic polypropylene.
- 1998 Spring Semester at Boston University.  
Attendance of three courses (Physical Chemistry II, Laboratory of Physical Chemistry and Reaction Mechanisms in Organic Chemistry) as exchange student. Final average: A.

### PROFESSIONAL POSITIONS:

- 2015 – Associate Professor at the Department of Chemical Sciences.
- 2007 - Assistant Professor at the Department of Chemical Sciences.
- 2006-2007 Post-Doc at the Department of Chemical Sciences.
- 2004-2005 Post-Doc grantee of Federchimica (Association of Italian Chemical Industries)
- 2001-2003 Supervisor of the Chemistry Section – Contact Traces Laboratory. Reparto Carabinieri Investigazioni Scientifiche (Forensic Science Unit of Carabinieri, the national police force of Italy).

### RESEARCH INTERESTS:

Structural and Morphological Characterization of Materials, especially Polymers and Polymer-based Nanocomposites  
Forensic Analysis of polymer-based items and contact traces  
Crystallization Behavior of Materials

Valerio Causin research activity is centered on the structural and morphological characterization of materials, by small-angle X-ray scattering, wide-angle X-ray diffraction, thermal analysis and optical and electronic microscopy. Such expertise is directed towards the quest for structure-property relationships, especially in the field of nanocomposites. The latest development of his research activity is on the use of electrospun nanofibers for the manufacturing of nanocomposites based on biodegradable polymeric matrices. An important application of his studies is in forensic sciences, where he applies material science characterization techniques to items connected to crime scenes, with the aim of singling out their source. V.C. collaborated with Lyondell Basell, Akzo Nobel and Solvay-Solexis and participated to several projects co-financed by the Italian Ministry of Research and by the European Union.



*Dr. Valerio Causin, PhD*

He initiated a number of collaborations both with other groups of the Department of Chemical Sciences of the University of Padua and with international research groups based in Singapore, India, Nepal, South Korea and South Africa. Research in forensic science is on the other hand carried out in collaboration with the Forensic Branch of Carabinieri, in Rome and Messina, and with judges and lawyers all around Italy.

He served and currently serves as a referee in the peer review process of a number of international journals, such as Journal of The American Chemical Society, Polymer, Journal of Applied Polymer Science, European Polymer Journal, Polymer International, Macromolecular Materials and Engineering, etc.

He also served as a reviewer for projects on behalf of the National Science Foundation (USA) / National Research Foundation (Sud Africa), of the Medical Research Council of South Africa, of the Romanian National Council for Research and Development and of the City University of New York.

In 2009 he was awarded the AIM prize for young researchers in polymer science.

In 2011 he was elected a member of the Scientific Committee of the POLYCHAR World Forum on Advanced Materials.

In 2011 he was invited by the China National Narcotics Control Commission of the People's Republic of China to hold a workshop on the analysis of drug packaging for forensic intelligence purposes.

In 2015 he received the International Materials Science Prize awarded by Scientific Committee of PolyCHAR World Forum on Advanced Materials.

V.C. authored one monograph, more than 80 articles in international journals and five book chapters. He presented more than 50 communications in national and international congresses, often as an invited or keynote speaker.

#### **UNIVERSITY, SCHOOL, AND DEPARTMENT SERVICE:**

University of Padua

2003-2004 and 2007- Department of Chemical Sciences – Member of the Dept.Council

2011- Member of the Didactic Commission of the Department of Chemical Sciences

2010- Member of the Chemical Degree Commission of the Courses of Studies in  
Chemistry and Industrial Chemistry

#### **PROFESSIONAL CONSULTING:**

2003- Consultant of several industrial laboratories, employed in cases where it was necessary to identify the cause of, and propose effective solutions to, damage and failures of polymeric objects.

2002- Forensic Consultant of the Judge, the Prosecutor, the Defendant and the Plaintiff in a variety of criminal and civil trials all over Italy and San Marino on the analysis of fire accelerants, metal debris, fibers and damage to textiles and inks.

#### **PROFESSIONAL ASSOCIATION MEMBERSHIP:**

Ordine dei Chimici (Italian Register of Professional Chemists)

Albo dei Consulenti Tecnici d'Ufficio del Tribunale di Venezia (Bar of the Forensic Consultants in Civil Justice)

Albo dei Periti del Tribunale di Venezia (Bar of the Forensic Consultants in Criminal Justice)

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