Ernesto DI MAIO

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DATE OF BIRTH:	April 18th 1975
PLACE OF BIRTH:	Naples
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EDUCATION

1/2004 to date **Assistano Professor** in Materials Science and Technology Department of Materials and Production Engineering, Faculty of Engineering, Università degli Studi di Napoli Federico II

2001-2004 **Researcher** in Polymer Science at Institute of Composite and Biomedical Materials, National Research Council, Italy

1998-2001 **PhD** in Technology of Materials and Process
University of Naples
Faculty of Engineering
Department of Materials and Production Engineering
Tutors: Prof L. Nicolais, Prof. S. Iannace

*My PhD Thesis was about the **physics** and the **thermodynamics** of **foaming process** of biodegradable thermoplastic polymers; I also modeled the mechanical and thermal properties of the cellular structures.*

Fall Semester 2001 **Visiting Research Scholar**
Department of Chemical Engineering, University of Houston, Houston, Tx
Prof. Raimond W. Flumerfelt

1993-1998 **Degree** in Materials Engineering
University of Naples Faculty of Engineering

Specialization:	Structural materials
Average grade:	29.7 out 30
Final grade obtained:	110 out 110 cum laude
Experimental Thesis in:	Composite materials; Prof. G. Caprino, dept. of Materials and Production University of Naples.

*My thesis was about **delamination of composite materials**. I made tests in **mode I, II** and mixed **I/II** and evaluated the energy released upon delamination.*

1988-1993 **Scientific-oriented High school**, Caserta

PUBLICATIONS

S. Iannace, E. Di Maio, L. Nicolais, *Preparation and characterization of polyurethane porous membranes by particulate-leaching method*, Cellular Polymers, 5 (2001) 321

W. Di, S. Iannace, E. Di Maio, L. Nicolais, *Nanocomposites by Melt Intercalation Based on Polycaprolactone and Organoclay*, Journal of Polymer Science: Part B: Polymer Physics, 41 (2003)

S. Iannace, E. Di Maio, Y.W. Di, G. Mensitieri, L. Nicolais, *The foaming process of biodegradabile polyesters*, Biodegradable Polymer and Plastics, E. Chiellini, R. Solaro Eds., Kluver Academic/Plenum Publishers, London, 2003

S. Cotugno, E. Di Maio, C. Ciardiello, S. Iannace, G. Mensitieri, L. Nicolais, *Sorption Thermodynamics and Mutual Diffusivity of Carbon Dioxide in Molten Polycaprolactone*, Industrial Engineering and Chemical Research, 42 (2003) 4398

E. Di Maio, S. Iannace, Y. Di, E. Del Giacomo, L. Nicolais, *Heterogeneous bubble nucleation in PCL/clay nanocomposite foams*, Plastics Rubbers and Composites, 32(2003) 313

S. Cotugno, E. Di Maio, S. Iannace, G. Mensitieri, "Microcellular Biodegradable Polymeric Foams Produced From Supercritical Fluids and Nanocomposite Solutions", in Material & Process Technology-The Driver for Tomorrow's Improved Performance, Ed. K. Drechsler, Publ. by SAMPE EUROPE (Aalsmeer, NL), pag. 400-405 (2004), ISBN 3-9522677-1-6

E. Di Maio, S. Iannace, L. Sorrentino, L. Nicolais, *Isothermal crystallization in PCL/clay nanocomposites investigated with thermal and rheometric methods*, Polymer Vol 45/26, pp 8893-8900 (2004)

S. Cotugno, E. Di Maio, S. Iannace, G. Mensitieri, L. Nicolais, *Biodegradabile foams* in Handbook of Biodegradabile Polymeric Materials and their Applications, Ed. B. Narasimhan e S.K. Mallapragada, American Scientific Publishers, 2005, ISBN 1-58883-053-5

E. Di Maio, S. Iannace, L. Nicolais, W. Li, R.W. Flumerfelt, *Structure optimization of PCL foams by using mixtures of CO_2 and N_2 as blowing agents,* accepted on Polymer Engineering and Science

SCIENTIFIC AND TECHNICAL ACTIVITIES

My research work is focused on the production of cellular structures made with biodegradable polymers. This study covers two aspects: a) the basic study of thermodynamics and

physics of foam formation and b) the technological process of foam extrusion. The aim is to understand the influence of the processing parameters on the morphology of the cellular structures.

The foaming process of poly(caprolactone) (PCL) using CO2 under pressure has been investigated by examining issues related to CO2 sorption thermodynamics and kinetics and issues related to rheology of PCL melt with dissolved CO2. To this aim, CO2 sorption experiments were performed at temperatures ranging from 70 to 90°C and pressures up to 6.5MPa, in order to gather information on CO2 diffusivity and solubility in the PCL melt. CO2 sorption data were correlated by using Sanchez and Lacombe equation of state (SLEOS) theory. Parameters of SLEOS for pure PCL melt were obtained by performing PVT experiments at several temperatures (60-120°C) and pressures (up to 200MPa). Evaluation of the PCL melt viscosity with dissolved CO2 was performed by in-line rheometric measurements during extrusion, by using a capillary device. The theoretical study will also concern the modeling of the cell growth process, to get an analysis tool of the effects of processing variables on the density and the morphology of the cellular structures.

By examining the extrusion process, we could observe that commercial biodegradable polymers are not suitable for foaming: in particular they have poor rheological properties and the polymer constituting cell walls is not able to withstand the elongational stresses during cell growth. This is the reason for cell collapse, which determines the rise of foam density and the deterioration of the cellular morphology.

We faced this problem in two ways, modifying the material (in this case PLLA) by enhancing its rheological properties and modifying the foaming process, to best control each process involved in foam formation.

Solid post condensation treatments have been performed on PLLA, to give the material a higher melt strength. These treatments resulted efficient in affecting the molecular weight and the viscosity of the material. In this study we also analyzed the effect of the treatment on the crystallinity of the samples.

The extrusion process has been modified to attain microcellular foams, by using static mixes and nucleation nozzles, to best control the temperatures and the pressures during extrusion. This system provides a complete monitoring and analysis of the different process of gas solubilization, nucleation, growth and stabilization of the foam.