



Hellenic Polymer Society

ELEP SEMINAR

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Deciphering structure/property interrelations for functional polymer systems using thermal analysis

Prof. Natalie Stingelin

Chair, School of Materials Science and Engineering

Director, Georgia Tech Center for Organic Photonics and Electronics

Georgia Institute of Technology

natalie.stingelin@mse.gatech.edu

Abstract

In recent years, immense efforts in the functional polymer field have led to unprecedented progress and to numerous new opportunities for polymers in, e.g., electronics, energy storage, energy harvesting, health care, and beyond. Despite these advances, many challenges still exist: predicting properties, identifying reliable processing protocols and, more fundamentally, gaining a complete understanding of the way structural features over all length scales affect functions in macromolecular matter, including electron/ion transport, charge generation, ferroelectric characteristics, and/or photophysical processes. Here we demonstrate how classical polymer science tools can be used to elucidate the structure development of functional polymers from the liquid phase, how such knowledge can be exploited to manipulate their phase transformations and solid-state order and, in turn, their performance. We provide examples how side-chain softening can influence mechanical and optoelectronic properties, and how vitrification can dominate the structure formation of ferroelectric:semiconducting polymer blends. We moreover discuss how differential scanning calorimetry techniques, including fast calorimetry, can be used for the identification of thermodynamic transitions of “unusual” polymers, including hairy-rod polymers (used, e.g., in organic solar cells) or high-refractive index inorganic:organic hybrid materials. Generally, we will demonstrate how thermal analysis can be exploited to obtain important structural information of these new material classes and, in turn, how processing guidelines can be established towards materials of specific optical or electrical characteristics, towards improved materials design and new understanding of this next generation polymer systems.

Natalie Stingelin

Chair, School of Materials Science and Engineering
Director, Georgia Tech Center for Organic Photonics and Electronics
Georgia Institute of Technology
Atlanta, GA 30332

E-mail: natalie.stingelin@mse.gatech.edu

Webpage: <https://stingelin-lab.gatech.edu>



Short Bio

Professor Natalie Stingelin is a materials scientist and currently the Chair of the School of Materials Science and Engineering at the Georgia Institute of Technology (Professor since 2016; Chair since 2022). Prior to this, she held positions at Imperial College London, Queen Mary University of London, the Philips Research Laboratories in Eindhoven, the Cavendish Laboratories, University of Cambridge, and the Swiss Federal Institute of Technology (ETH) Zürich. She served as Chaire Internationale Associée by the Excellence Initiative of the Université de Bordeaux (2017-2022). She is Editor-in-Chief of the *Journal of Materials Chemistry C* and *Materials Advances*, and is a Fellow of the National Academy of Inventors, the Materials Research Society, and the Royal Society of Chemistry.

Professor Natalie Stingelin studied Materials Science & Engineering at the Department of Materials, ETH Zürich, and obtained the degree of Engineer in Materials Science in 1997. In 2001, she completed her doctoral studies in the Polymer Technology Group, for which she was awarded the ETH Medal – the highest honor that can be received for a PhD thesis at ETH Zürich.

Her research focuses on the broad field of organic functional materials, including organic electronics; multifunctional inorganic/organic hybrids; smart, advanced optical systems based on organic matter; and bioelectronics. She has published more than 230 papers and she holds 6 issued patents. She was a co-investigator of the EPSRC Centre for Innovative Manufacturing in Large Area Electronics, and she led the EC Marie-Curie Training Network 'INFORM' that involved 11 European partners.

Awards

- 2011: ERC Starting Independent Researcher Grant
- 2012: Fellow of the Royal Society of Chemistry (FRSC).
- 2014: Institute of Materials, Minerals and Mining Rosenhain Medal and Prize
- 2015: Chinese Academy of Sciences President's International Fellowship Initiative
- 2015: ERC Proof-of-Concept Grant
- 2016: Chair of the Gordon Research Conference on Electronic Processes in Organic Materials
- 2016: Presenter at the Davos World Economic Forum's Idea Lab: <https://www.youtube.com/watch?v=u8OF2Y-p8v0>
- 2019: Fellow of the Materials Research Society
- 2021: Engineering and Physical Sciences Suffrage Science Award
- 2021: French-British Prize, French Chemical Society/Royal Society of Chemistry (UK)
- 2021: Fellow of the National Academy of Inventors