**UNIVERSITY OF SOUTHERN CALIFORNIA**

**DEPARTMENT OF CHEMISTRY**

# Organic / Materials Chemistry Seminar

# "Seeing is Believing: High-Resolution Scanning Probe Microscopy of Conjugated Polymers"


## Professor Giovanni Costantini

Department of Chemistry
University of Warwick
United Kingdom


Wednesday, October 24, 2018
3:00 PM
Olah Library

*Hosted by Prof. Barry Thompson*

*Scientific Community is Invited*

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# Seeing is believing: high-resolution scanning probe microscopy of conjugated polymers

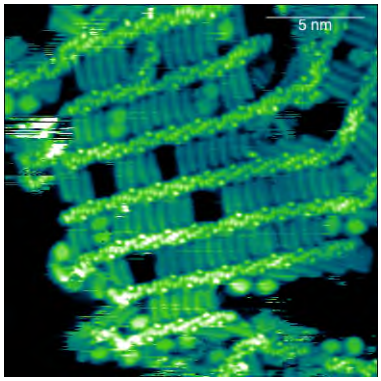
Giovanni Costantini

*Department of Chemistry, University of Warwick, Coventry, CV4 7AL, UK*

The structure of a conjugated polymer and its solid-state assembly are without a doubt the most important parameters determining its properties and performance in (opto)-electronic devices. A huge amount of research has been dedicated to tuning and understanding these parameters and their implications in the basic photophysics and charge transporting behaviour. The lack of reliable high-resolution analytical techniques constitutes however a major limitation, as it hampers a better understanding of both the polymerisation process and the formation of the functional thin films used in devices.

Here, by combining vacuum electrospray deposition and high-resolution scanning tunnelling microscopy (STM) we demonstrate the ability of imaging conjugated polymers with unprecedented detail, thereby unravelling structural and self-assembly characteristics that have so far been impossible to determine.

Applying this novel technique to prototypical conjugated polymers, we show that sub-molecular resolution STM images allow us to precisely identify the monomer units and the solubilising alkyl side-chains in individual polymer strands. Based on this, it becomes possible to determine the molecular number distribution of the polymer by simply counting the repeat units. More importantly, we demonstrate that we can precisely determine the nature, locate the position, and ascertain the number of defects in the polymer backbone.[1] This unique insight into the structure of conjugated polymers is not attainable by any other existing analytical technique and represents a fundamental contribution to the long-discussed issue of defects as a possible source of trap sites. Furthermore, the analysis of our high-resolution images univocally demonstrates that one of the main drivers for backbone conformation and polymer self-assembly is the maximization of alkyl side-chain interdigitation. On this basis, we investigate the 2D assembly of a series of conjugated polymers with varying backbone chemical compositions to explore the range of applicability of a simple model for linear alkyl side-chain interdigitation based on the maximisation of van der Waals interactions.[2]




*High resolution STM image of poly($C_{14}$DPPF-F) on Au(111).*

1. D.A. Warr, L.M.A. Perdigão, H. Pinfold, J. Blohm, D. Stringer, A. Leventis, H. Bronstein, A. Troisi, G. Costantini, *Sci. Adv.* **4**, eaas9543 (2018).
2. D.A. Warr, *et al.*, in preparation.