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SPECIFIC POLYMERS - Functional polymers and materials for optoelectronic devices and sensors

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Abstract

SPECIFIC POLYMERS is a SME acting as R&D service provider in the field of functional monomers, polymers and materials with high specificity. In more than 12 years, SP has developed the synthesis of more than 1000 functional building blocks, monomers and polymers and is now working with more than 400 customers and partners in more than 30 countries worldwide in all field of applications such as surface finishing (glass, metal, metal oxides, nanoparticles, plastics), aeronautic, automotive, pharmaceutical industry, cosmetic, electronic, optic, energy (fuel cells, solar cells or lithium batteries). Since 2013, SP is developing innovative materials for electronic devices. As for example, SP is involved in PiezoMAT European Project and develops UV-crosslinkable thin layer polymeric materials for the encapsulation of ZnO nanowires (NWs) in multi-NWs pressure based fingerprint sensors.

Peer-review under responsibility of the organizing committee of the 30th Eurosensors Conference

*Keywords:*SPECIFIC POLYMERS, organic chemistry, polymer chemistry, functional material, on-demand synthesis, R&D service provider

Nomenclature

SP	SPECIFIC POLYMERS
SME	Small and Medium sized Entreprise
R&D	Research and Development

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1. SPECIFIC POLYMERS – R&D service provider

SPECIFIC POLYMERS (www.specificpolymers.fr) was created in 2003 in order to meet the need of international high tech industrial groups in terms of specifically designed monomers, polymers and materials. is a SME with 11 employees with an annual turnover of about 1 M€ in 2016. SP acts as R&D service provider and scale up producer in the field of functional monomers & polymers with high specificity. In more than 12 years, SP has developed the synthesis of more than 1000 functional building blocks, monomers and polymers and is now working with more than 400 customers and partners in more than 30 countries worldwide. Monomers and polymers provided by SPECIFIC POLYMERS are used for a very wide range of applications. SP activity can be summarized in four points:

- RESEARCH AND DEVELOPMENT of innovative polymers
- ON-DEMAND SYNTHESIS of building-block, monomers and polymers
- CATALOG PRODUCTS supplier (more than 1000 molecules)
- UP-SCALED PRODUCTION from gram to hundred grams

The main goal of the innovative product developed by SP is to validate proof of concepts in close collaboration with the customers. Due to its strong skills in organic and polymer chemistry, SP is able to develop innovative materials with specifically designed properties (Fig. 1). In other words, SP propose R&D services for academic laboratories and R&D departments of high tech industrial groups.

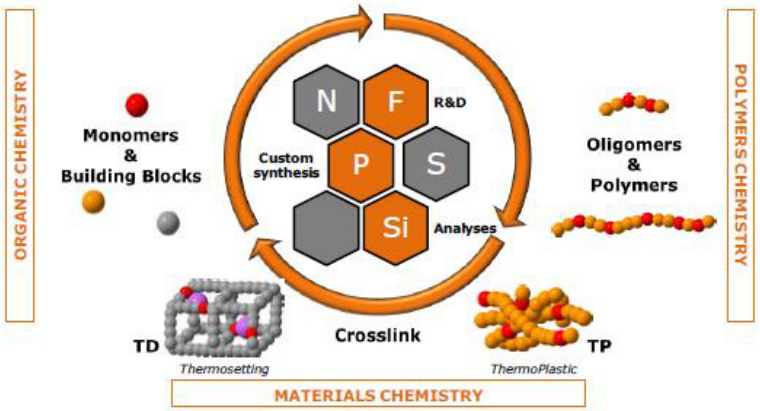

Fig. 1: SPECIFIC POLYMERS – R&D partner for functional polymer and materials

2. SPECIFIC POLYMERS – Expert in monomer, polymer and materials

SPECIFIC POLYMERS activity consists in the design, the development and the production of functional building-blocks, monomers, polymers (Fig. 2). Functional groups developed by SP are mainly based on the chemistry of phosphorus, silicon, alcoxysilane, epoxy and carbonates but can also be moieties such as amines, alcohols, carboxylic acid, mercaptan, chlorine, bromine, iodine, propargyle, azide, etc. SPECIFIC POLYMERS also have strong competences in the preparation of organic material such as epoxy resins, polyurethanes or phenolic resins. Thanks to our skills in organic and polymer chemistry, SP masters most of the crosslinking reactions that enable the preparation of materials: epoxy-amine, epoxy-anhydrid, carbonate-amine, epoxy-phenol, isocyanate-alcohol, azide-propargyle, acrylates-peroxides, acrylate-UV, etc. Controlling the functionality of the molecules used allow mastering the crosslinking degree and thus the mechanical performances of the corresponding material. Additionally, SP has strong competences in the synthesis of building-blocks, monomers and polymers bearing alcoxysilanes groups and is able to develop innovative SOL-GEL materials.

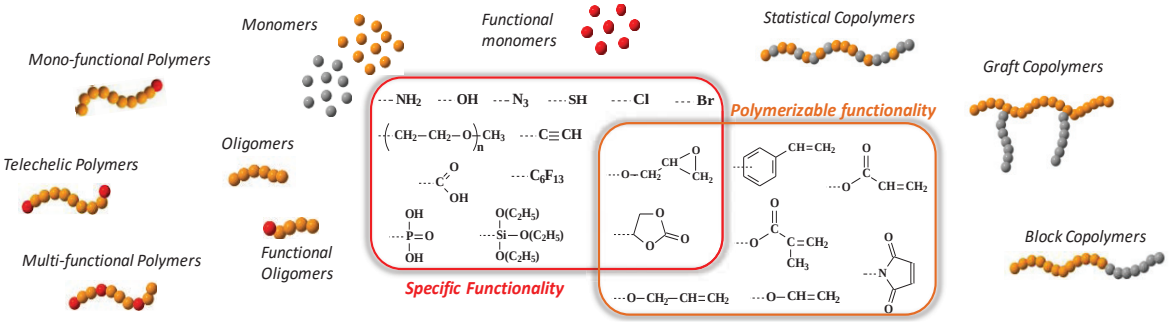

Fig. 2: SPECIFIC POLYMERS – Expert in functional building-blocks, monomers and polymer

3. SPECIFIC POLYMERS – Research Force and Infrastructure

With a team composed of 3 PhDs, 5 Engineers and 2 Technicians specialized in organic and polymer chemistry, the whole company is dedicated to research activities. SP laboratory equipment's includes organic synthesis equipment (grams to kilograms), Polymer synthesis equipment (grams to kilograms) and analyses equipments (Nuclear Magnetic Resonance (NMR – Bruker 300 MHz) ^{1}H, ^{13}C, ^{19}F, ^{31}P, COSY, 2D DOSY ; Size Exclusion Chromatography (SEC – Agilent technologies, RI, THF) ; Differential Scanning Calorimetry (DSC – TA Instrument Q2000) ; InfraRed Analysis (IRTF, Perkin Elmer –ATR Module) ;Brookflied viscosity (Brookfield RV Viscosimeter – DV-I Prime)).

Since 2010, SP experiences a substantial growth that led to its recent move to its own building and consequently to considerably increase its workspace (more than 600 square meters of working space). Such a space allows developing R&D and analytical activities but also permit to settle an activity of formulation and processing (spin-coating, bare-coating, photopolymerization conveyor).

4. SPECIFIC POLYMERS – Materials for opto-electronic devices and sensors

4.1. Materials for optoelectronic devices

Since 2013, SP is working on innovative materials for optoelectronic devices such as Fingerprint sensors, Organic PhotoVoltaic (OPV), Organic Light-Emitting Diodes (OLED) or Organic Field Effect Transistor (OFET). (Fig. 3)

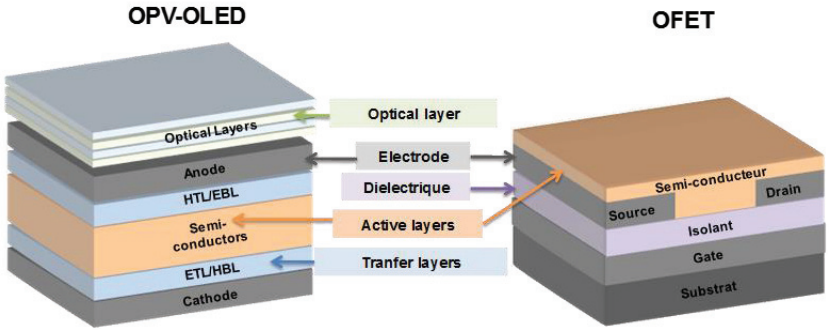

Fig. 3: SPECIFIC POLYMERS – Thin layer materials for optoelectronic devices

In such devices, SP is developing innovative thin layer materials: low and high Refractive Index materials for optical layers, hybrid materials for electrodes, insulating dielectric polymer materials and building-blocks and polymers for electron and hole transporting layers. In every case, the products developed were built up to answer one specific request and to reach defined physicochemical properties.

4.2. PiezoMAT Project – Encapsulation material for multi-NWs pressure based fingerprint sensors

In the field of sensors, SP is developing encapsulation polymeric materials in the scope of PiezoMAT Project in which multi-NWs pressure based fingerprint sensors are developed (Fig. 4).

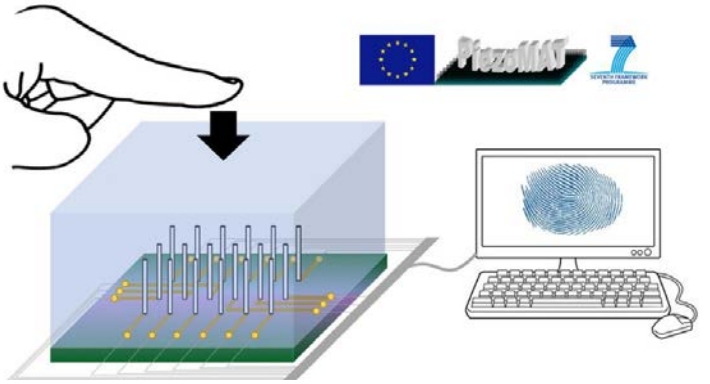

Fig. 4: SPECIFIC POLYMERS – encapsulation materials for multi-NWs pressure based fingerprint sensors (PiezoMAT European Project)

The sensing principle is based on the piezoelectric property of ZnO NWs, *i.e.* a potential difference is generated on the NWs when they undergo compression and/or bending forces. Since the finger pressure cannot be directly applied on the NWs, the deformation is applied through a polymeric material exhibiting specific properties. In the scope of this project, SP developed a polymeric encapsulation thin layer exhibiting appropriate mechanical to protect the NWs from breaking while allowing their deformation in order to produce electric charges. To implement such encapsulation layer, the research work was oriented toward the development of multi-component solvent-free spin-coating processable and UV-crosslinkable materials. On the one hand, the spin coating process was selected since (i) a liquid deposition system must ensure the encapsulation material to be well-spread on the seed layer and in the NWs vicinity and (ii) because it allows controlling the encapsulation layer thickness by varying the spin-coating rotation speed. On the other hand, the UV-curing process, which is an efficient and time saving process commonly used in industry, was selected because it allows accessing to crosslinked and chemically inert material from liquid and easy processable formulation of acrylate (macro)molecules. 1,6-hexanediol diacrylate and poly(propylene glycol) diacrylate were the main two components of the crosslinkable formulation. Studies made on such encapsulation layers revealed that it was possible to prepare a polymeric crosslinked thin layers with appropriate Young modulus and thickness so as to favor optimal voltage output.

5. Conclusion

SPECIFIC POLYMERS is a R&D service provider and scale up producer in the field of functional monomers, polymers and materials with high specificity. Since 2013, SPECIFIC POLYMERS is involved in more and more project in the field of optoelectronic devices and sensors. Thanks to these projects, SP is now able developing thin polymeric layers of all kinds for its customers (crosslinked encapsulation layers, low and high refractive index materials for optical layers, hybrid materials for electrodes, insulating dielectric polymer materials, building-blocks and polymers for electron and hole transporting layers). SPECIFIC POLYMERS is one of the Partners of PiezoMAT project and, in this framework, develop innovative UV-crosslinkable thin layers for the encapsulation of multi-NWs pressure based fingerprint sensors. SPECIFIC POLYMERS is willing to be involved in projects aiming at developing new polymeric materials for opto-electronic devices and sensors, so do not hesitate to contact us.

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