Research in polymers, biopolymers and advanced composite materials is developed following different themes, continuously updated to face the most recent trends in the field. The engineering approach in the development of innovative plastic solutions for advanced applications is applied by combining the chemistry of polymer synthesis and polymer chemical modification for the preparation of new molecular structures, with technological aspects dealing with polymer processability and applications in relevant industrial environments. Bio-based polymers (poly(hydroxyalkanoate)s, poly(lactic acid), bio-polyolefins and others) are deeply investigated to support their diffusion in different production chains, such as packaging, automotive, cosmetics, medicine, civil engineering and architectural restoration. Engineering polymers for metal replacement and hard environment applications are also studied. Particular interest is devoted to the study and modification of polymer surfaces and interfaces; examples are: - the development of tailored organic-inorganic nanostructures hybrid coatings to improve surface properties of common plastics (scratch and radiation resistance, barrier properties, flame resistance, antibacterial properties, etc.); - the chemical modification of polymers with perfluorinated segments to get omni-phobic, anti-adhesive and self-cleaning surfaces. Advanced composites and nanocomposites are developed with either traditional or bio-based polymer matrices, and reinforcing fillers range from natural fibers, to microcrystalline cellulose, to conductive carbon nanostructures (nanotubes, graphene) and tailored ceramics (hydroxyapatite, silicates, glasses, etc.). Mechanical, microstructural and thermal characterization of traditional and innovative polymeric materials is performed. Special focus is ad-dressed to investigate the relationship occurring between microstructure and macroscopical properties of the polymer. An important aspect is related to the study of polymer degradation in specific and tailored environmental conditions (oxygen, temperature, UV radiation, relative humidity, body fluids).

The life-time of the polymer is evaluated through the choice of suitable diagnostic properties. Technological aspects, mainly related to polymer processing, are also faced in strict collaboration with national and international Companies working with plastics; the suitability and potential of different polymers for specific industrial applications is evaluated also with field testing and practical feasibility studies. Mechanical and chemical polymer recycling is also studied.

Fig. 1. Polymer recycling: example of phase-separated, compatibilized PE-PET blend (picture by P. Fabbri)

Fig. 2. Electrically conductive bionanocomposite filled with multi-walled carbon nanotubes (picture by P. Fabbri)
MAIN PUBLICATIONS


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