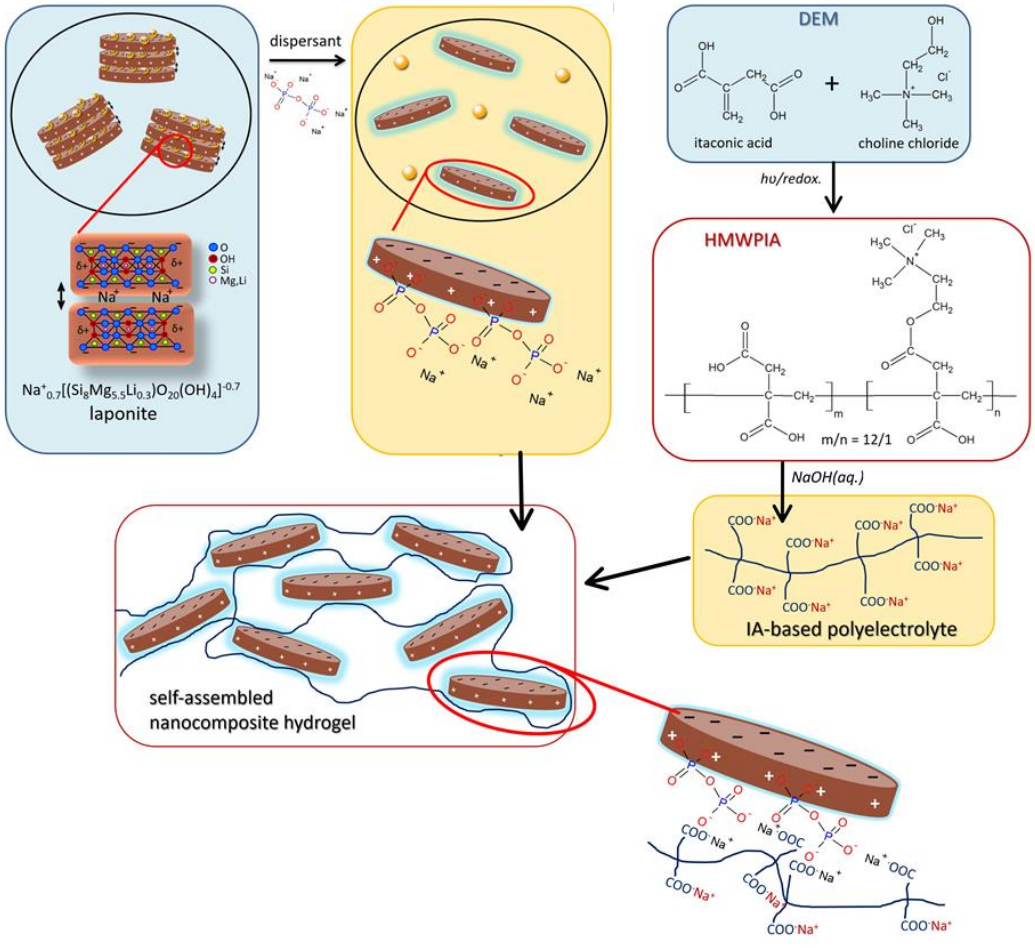
Biomass-derived itaconic acid-based polyelectrolytes for synthesis of self-assembled nanocomposite hydrogels

Development of bio-based polymers as alternatives to conventional petrochemical polymers is currently highly actual topic due to global environmental concerns. Moreover, the use of renewable (biomass) feedstock contributes to the European circular economy and to more sustainable polymer production. Based on intensive market research, itaconic acid (IA) has been identified as one of bio-based building blocks, which is the most interesting for the development of attractive end-use applications. IA has become an important renewable monomer, considered as bio-based alternative to petrochemical acrylic / methacrylic acid.

This project explores our very recent findings that daylight-induced and initiator-free polymerization of Deep Eutectic Monomers (DEMs) enables synthesis of IA-based polyeletrolytes with unexpected high-molecular weight (HMWPIA), which are suitable for fabrication of physical hydrogels. Radical polymerization of IA-based DEMs will be studied in details, especially in the context of initiation / termination processes in very viscous polar media strongly structured by hydrogen bonds with the aim to explore the effects of DEM structure / chemical composition on HMWPIA structure and properties. The self-assembling behavior of the polyelectrolytes in the nanoparticle/dispersant aqueous systems will be studied with the aim to produce physical mechanically-robust nanocomposite hydrogels with morphology and structure-related properties fully driven by ionic interactions.

The project is oriented to obtain new basic knowledge, which could be used to create new, or make improvements on existing products. For example, our nanocomposite hydrogel materials could be useful in agriculture, enhancing water and nutrient use efficiency as well as superabsorbent for healthcare and hygienic products. In addition, the mentioned materials have potential use in controlled drug release, tissue engineering, and biofabrication applications. It is worth mentioning that these nanocomposite hydrogels can be efficiently fabricated by reactive injection molding or 3D-printing in various forms, such as sheets, hollow tubes, and other mould's shapes, what is very important from practical point of view.



Synthesis of HMWPIA, nanoclay modification and plausible visualization of nanoclay interactions allowing formation of physical crosslinked nanocomposite hydrogel via supramolecular assembling.