

Sustainable Bioplastics 2016 - Novel approaches in hydrogel design from chemically-modified polysaccharides

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Polysaccharides constitute an important class of biopolymers. They usually display biocompatibility and biodegradability, which are the basic characteristics for polymers used as biomaterials, and some of them exhibit unique physical and/or biological properties. We would like to report here new strategies for the chemical modification of water-soluble polysaccharides, such as hyaluronic acid (HA) and carboxymethylcellulose (CMC), providing access to smart hydrogels and nanogels (hydrogels confined to submicrometric dimensions) for drug/cell delivery. Using thiol-ene reactions, we successfully grafted thermosensitive ethylene-glycol based copolymers on HA, allowing temperature-triggered assembly of the polysaccharide into nanogels with diameters < 200 nm. These gel particles possess many interesting features for drug delivery, like: facile formation, tunable size and stability, easy loading of hydrophobic molecules, high selectivity and binding affinity for cancer cells expressing the CD44 receptor of HA, degradation behavior due to the inherent biodegradability of HA. In addition, after intravenous injection in mice, they were shown to enter the blood circulation. Thiol-ene reactions were also applied to engineer macrogels of HA and CMC. We showed the ability to obtain self-healing hydrogels in physiological conditions by the careful design of HA modified with phenylboronic acid and sugar derivatives. Moreover, by combining lipid nanoparticles (LNPs) and carboxymethylcellulose (CMC) hydrogels, we developed original hybrid biomaterials that are able to provide local delivery of hydrophobic therapeutic agents in a predictable and sustained manner. These new delivery systems offer promising platforms for the controlled release of various drugs under certain external stimuli.

As an illustrative model, the thermodynamic and electrochemical standards checked on in this section are applied to a complex electrochemical framework, the immediate ethanol energy component (DEFC), surveying ongoing work on this issue and proposing future research directions. Although they don't require energizing and work insofar as fuel keeps on being given. There are four driving sorts of fills investigated in this part, proton trade layer energy components (PEMFCs) working on clean hydrogen, direct liquor (principally methanol) power modules (DAFCs), strong oxide energy components (SOFCs), and liquid carbonate power devices (MCFCs). PEMFCs and DAFCs ordinarily work at underneath 100 °C and are focused on fundamentally for transportation and portable applications, while SOFCs and MCFCs, which have at fevers over 600 °C, can run on a wide assortment of powers and are planned generally for fixed joined warmth and force applications. This survey is centered basically around a

portrayal of every one of these advances, with an accentuation on the materials utilized in the terminals, the electrolyte that isolates them, and the present authorities.

A power module is an electrochemical gadget that changes over the synthetic vitality put away in a fuel and an oxidant straightforwardly into power, warmth, and response items. The electric flow is produced by a couple of redox responses that happen isolated by an electrolyte. At the anode, the fuel is oxidized, producing electrons and particles, while at the cathode the oxidant is diminished, devouring the electrons and particles created at the anode. The electrolyte is explicitly planned with the goal that it can't direct electrons, which move through an outer circuit performing electrical work, while it permits the progression of particles expected to keep up worldwide electrical lack of bias. In contrast to traditional batteries, power modules necessitate that the fuel and the oxidant be provided ceaselessly to support the electrochemical responses.

Until now, just few studies have been published in the literature that used silanes in systems based on Portland cement without polymer modification⁶⁻¹¹. These studies reported surfaces of fibers, silica fumed, and cenospheres being modified with silanes or organosilanes which were added in mortars and concretes during mixing. In all cases, it was observed an increase on mechanical properties, but the mechanism of interaction was not deeply investigated. More recently, it was identified the possibility of developing strong bonds between some organosilanes and cement through covalent bonds¹²⁻¹⁴. Moreover, when considering EVA interaction with organosilanes, limited content of researches have been published and minor improvement on adherence was actually achieved^{15,16}.

The possibility of bonding improvement at the interface between ceramic tiles and polymer modified mortars (PMM) is decisive for assuring stability to the adhered method as a reliable choice in ceramic tile installation. For this reason, in the last years, around the world, the lack of confidence has raised the concern from ceramic tiles and mortar industries with an overall result of reduction on the industrial growth and, indirectly, it has an adverse impact upon all manufactures, merchants and installers¹⁷⁻¹⁹. Besides that, when evaluating ceramic tile systems failures, adhesive rupture between cladding and modified mortar was observed in 84% of the buildings²⁰. This value is not totally surprising when considering that the modeling of ceramic tile coverings behavior reveals the highest shear stresses in tile/tile bed interface, mostly related to stresses caused by moisture expansion or thermal movements²¹.

Hence, the main goal of this work was to promote a novel chemical functionalization of ceramic tiles surfaces by modifying with trialkoxysilanes coupling agents to generate an organic layer onto inorganic tile so as to reinforce the interface adhesion between tile and polymer modified mortar.

Soda-lime glass tiles ($\text{SiO}_2 \approx 70$ wt. (%); $\text{Na}_2\text{O} \approx 15$ wt. (%); $\text{CaO} \approx 10$ wt. (%)) with dimensions of fifty x 50 mm were selected to be used as template for modeling the effect of silane modification within the adherence between EVA modified mortar and silane modified tile. This choice was supported the chemical similarity of glass tile compared to ceramic tile related to the vitreous phase and composition for mimetizing inorganic substrate properties.

Glass tile surfaces were prepared with five silane derivatives bearing specific functionalities. Amino ($-\text{NH}_2$), mercapto ($-\text{SH}$), vinyl ($-\text{CH}=\text{CH}_2$), methacrylic ($\text{CH}_2=\text{C}(\text{CH}_3)\text{COO}-$), and isocyanate ($-\text{N}=\text{C}=\text{O}$) groups were chosen as reactive groups of coupling agents (Table 1) for evaluating their relative compatibility with the EVA mortar. The silanes were supplied by Sigma-Aldrich. Glass tile without any chemical modification (as supplied) was used as reference.

Biography :

Rachel Auzély-Velty has completed her PhD from the University of Rennes (Rennes, France) in 1997 and post-doctoral studies at the Commissariat à l'Energie Atomique (CEA, Saclay) in 1998-1999. After being a CNRS researcher in the CNRS research laboratory, CERMAV (Grenoble) from 1999 to 2005, she became full professor at the University Grenoble Alpes (Grenoble). She has published more than 80 papers related to polysaccharide chemistry in reputed journals. She was a Junior member of the Institut Universitaire de France (IUF) (2009-14) and named "Knight of the National Order of Merit" by the French minister for Research (2014).

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