Bionanocomposite Hydrogels Effectively Cross-linked with Functionalized Nanoparticles

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Abstract

Bionanocomposite (BNC) hydrogels have recently attracted lots of interest due to new properties introduced by synergetic effects between their organic and inorganic components [1]. The combination of inorganic nano-species such as nanoparticles (NPs) with soft and elastic three-dimensional hydrogel networks results in materials with enhanced performance. BNC hydrogels exhibit extraordinary mechanical, optical and swelling/deswelling properties when compared to conventional hydrogel homologues [2]. Moreover, nanocomposites stemming from biopolymeric hydrogels are of particular interest for preparation of drug delivery systems, scaffolds, biosensors and tissue engineering [1].
Recently, NPs were physically incorporated within hydrogel networks, usually involving a continuous release from the hydrogel matrix to the surrounding environment resulting in unwanted agglomerations or toxicity problems. In order to achieve the superior characteristics of BNC hydrogels and circumvent the aforementioned drawbacks, it is desirable for NPs to be immobilized by irreversible attachment to the polymeric chains [3]. In this way, NPs become an active structural, cross-linking element and act at the same time as a function carrier.
Several strategies are being used for the preparation of chemically cross-linked hydrogel networks to prevent the leaking of NPs during hydrogel applications. Herewith, we described a novel methodology to prepare BNC hydrogels based on the Diels-Alder (DA) reaction. The DA reaction is one of the common types of "click" chemistry which consists in a [4+2] cycloaddition between a diene and a dienophile to form an adduct [4]
In this work, chondroitin sulfate was used in combination with furan-modified gelatin using different types of maleimide-functionalized NPs. The preparation and the effect of the NPs on the cross-linking and structural, swelling and viscoelastic properties of hybrid hydrogels were studied and indicated the huge potential of these materials for biomedical applications.

References

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Figures

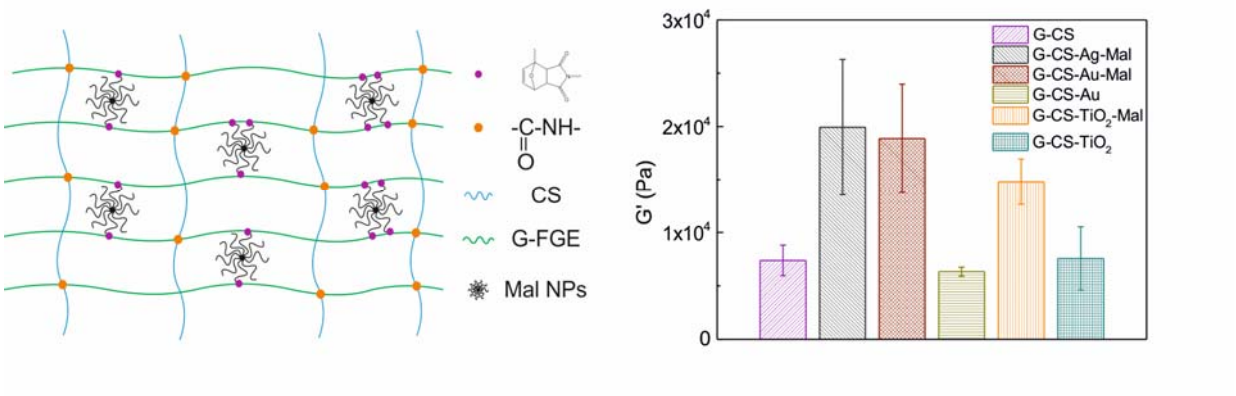

Figure 1. Representation of the BNC hydrogel network and mean storage moduli values (G') of different cross-linked and uncross-linked BNC hydrogels.