Highly stretchable and biobased composite for wound dressing

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Résumé

Wound dressings for movable joints/or vital organs require high stretchability and excellent resistance to applied deformations and forces. The biocompatible and soft hydrogels providing a moist wound environment are promising candidates to be applied for wound dressing of joints with frequent motions or post-surgical healing of mobile tissues. The most of existing hydrogels are brittle and break under small deformations. The double-network hydrogels or composites are designed for large deformations, however, they lack elastic properties due to the energy dissipation and cannot return to the initial state after deformation. In this work, we compare the mechanical properties of recently elaborated single-network stretchable and elastic hyaluronic acid (HA) hydrogel(1), and composite obtained after introduction of cellulose nanocrystals (CNC).

Firstly, the advantages of single-network will be demonstrated:

i) Simple and green method of preparation – HA pure hydrogel is obtained in a one-step method which relies on mixing polysaccharide solution with a biocompatible zero-length cross-linker, under physiological conditions, and without commonly used photoirradiation which may not be harmless for biological species if used in biomedical field

ii) Tuning of stretchability – It is possible to tune the extent of hydrogel elongation by varying different parameters such as HA molar mass, cross-linking density, and HA concentration. The molar mass is the most crucial parameter. While the low molar mass leads to brittle hydrogels, the high molar mass chains form entanglements which is a prerequisite to render hydrogel stretchable

iii) Elasticity with excellent recovery properties – the repeated loading-unloading cycles show negligible hysteresis and return to the initial state after deformation

Secondly, the influence of cellulose nanocrystals (CNC) on mechanical properties will be demonstrated. We show simple method of composite preparation and its characterization. We show that the toughness of the composite can vary with the amount of added CNC. The tensile strength can be improved while the elongation properties can be preserved.

Ref:
(1) Hyaluronic acid single-network hydrogel with high stretchable and elastic properties, A. Szarpak* et R. Auzély-Velty, *Carbohydrate Polymers, 2023, 320, 121212*

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