

Enhanced gold adhesion on sodium alginate films for green electronics: study of the role of oxygenated functional groups

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Sodium Alginate

Sodium alginate (SA) is a widespread, biodegradable biocompatible water-soluble biopolymer and extracted from brown algae with a strong tendency to form transparent free standing films whith controlled surface roughness. The constitutional repeating unit of the polymer consisits of 1,4-linked β -D-mannuronic units and α -L-guluronic units forming M, G and MGM



An interesting application of sodium alginate is in the green electronic field. In a previously published work^[1], a thin gold conducting layer was deposited by sputtering on SA flexible substrates and an outstanding adhesion phenomena was observed. In fact, as evidenced by a scotch tape test, the adhesion

Thermal evaporation

Sputtering

1.94

0.92



blocks as reported in figure.



Guluronic Block

Mannuronic Block Mannuronic-Guluronic-Mannuronic Block

Chemical Modification

In order to understand if the strong interaction **SA**-Au is more of a chemical or physical nature we have done some chemical modifications of SA, starting from hydroxyl moyeties which are supposed to form complexes with gold. The hydroxyl groups were acetylated while the carboxylic groups were transformed in methyl ester derivatives.



of the metal layer on **SA** is much stronger than that observed when the thermal evaporation technique is used for Au deposition.

Characterization of SA derivates



- ELEMENTAL ANALYSIS



Acetylated Alginic Acid^(c) (AcOAlg)

[1]: Determined By Stereomicroscope Leika IEZ4D at 30x magnification



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References

[1]Maccagnani, P., Bertoldo, M., Dinelli, F., Murgia, M., Summonte, C., Ortolani, L., Pizzochero, G., Verucchi, R., Collini, C., Capelli, R., Flexible Conductors from Brown Algae for Green Electronics. Adv. Sustainable Syst. 2019, 3, 1900001. https://doi.org/10.1002/adsu.201900001

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Gold polymer intercalation

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Gold on surface

SEM micrographs of surfaces were collected with the back-scattered detector in order to highlight differences between gold coating and polymeric substrate. Lighter areas are represented by gold, whereas darker ones identify the polymer. SA and the methyl ester derivative MeOCOAlg, which both resulted negative to tape test, show a pretty similar morphology with a mixed phase of Au/Polymer presumably due to a compenetration of the gold into the polymer. From the image of the acetyl derivative AcOalg, it is not possible to discern between lighter and darker domains, therefore we suppose that the gold coating is present only on the top of the polymer.