Transparent silk fibroin/silver nanowires nanocomposites for object recognition

Ander Reizabal, Sérgio Gonçalves, Nelson Pereira, C. M. Costa, Leyre Pérez, Jose-Luis Vilas, S. Lanceros-Mendez

BCMaterials, s/n, Edif. Martina Casiano, Pl. 3 Parque Científico UPV/EHU Barrio Sarriena, 48940 Leioa, Bizkaia, España

ander.reizabal@bcmaterials.net

Nowadays, multifunctional materials based on nanocomposites with polymer matrices generate a great interest because their remarkable properties result from the combination the fillers and polymer properties [1]. Within Polymer nanocomposites, those based on silver nanoparticles have attracted great interest into the scientific community due to their biocompatibility, chemical stability, optical, electronic, magnetic and catalytic properties of the silver in which also enhance the electrical properties of the nanocomposites [2].

These polymer matrices are commonly based on fossil fuels, so their use suppose the increase of our dependence on fossil fuels and the derived environmental impact. Considering this facts, the focus must be redirected for changing these polymer matrices by natural polymer [3].

However, are few the works focused on composites with silver nanoparticles as fillers and natural matrices. In these contest silk fibroin (SF) polymer within natural materials, deserves special attention because of its properties, such as non-toxicity, biocompatibility, biodegradability, excellent mechanical and thermal properties and offers a wide range of morphologies taking into account the processing technique [4].

Thus, this work proposes the development of silk fibroin nanocomposites based on silver nanowires (SNW) for the object recognition application. The obtained nanocomposites show optical transparency and excellent mechanical and thermal behaviour.

Given conductivity by SNW fillers together with the long aspect ratio result in mini-capacitor along the SF matrix, which endow nanocomposites with excellent dielectric behaviour. In addition, fillers movements through mechanical stimulus give to the SF/SNW nanocomposites a piezorresistive response. The combination of all the cited properties lead to the application of SF/SNW nanocomposites in an electronic device, with excellent results. This work, can be concluded to be a starting point for the coming future and pretend to be an additional reference for new materials generation based on natural based resources.

References

[1] Fu, S., et al., Some basic aspects of polymer nanocomposites: A critical review. Nano Materials Science, 2019. 1(1): p. 2-30

[2] Pinchuk, A.O., Size-Dependent Hamaker Constant for Silver Nanoparticles. The Journal of Physical Chemistry C, 2012. 116(37): p. 20099-20102.

[3] Ayre, D., Technology advancing polymers and polymer composites towards sustainability: A review. Current Opinion in Green and Sustainable Chemistry, 2018. 13: p. 108-112.

[4] Koh, L.-D., et al., Structures, mechanical properties and applications of silk fibroin materials. Progress in Polymer Science, 2015. 46: p. 86-110.

Figures

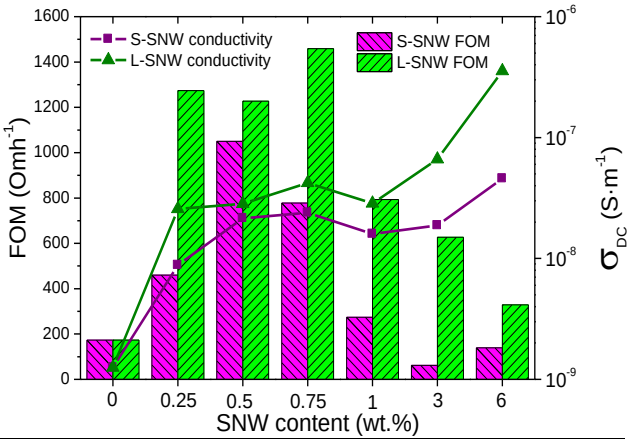

Figure 1: SF/S-SNW and SF/L-SNW samples figure of merit (columns) and D.C. conductivity (points)