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Cellulose hybrid nanocomposites using Napier grass fibers with *in situ* generated silver nanoparticles as fillers for antibacterial applications

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Abstract:

Initially silver nanoparticles (AgNPs) were *in situ* generated in Napier grass fibers (NGFs) and these nanocomposite NGFs were used as fillers (by 1 wt. % to 5 wt. %) in cellulose matrix to make hybrid nanocomposite films. The formation of *in situ* generated AgNPs on the surface of the NGFs was studied using scanning electron microscopy (SEM), high resolution transmission electron microscope (HR-TEM), Energy dispersive X-ray spectroscope (EDX) and X-ray photoelectron spectroscope (XPS). The HR-TEM analysis indicated the presence of spherical AgNPs on the surface of the fillers with a size ranging from 10 to 100 nm but majority of them in the 11 to 20 nm range. The POM images indicated the randomly oriented fillers in the hybrid composite films. Though the inflection temperatures of the hybrid composites were lower than for the matrix (due to catalytic activity of the AgNPs), the residual weights for them was higher than that of the matrix. The tensile strength of the hybrid nanocomposites varied between 73 MPa and 40 MPa while their tensile modulus between 4350 MPa and 2580 MPa for various filler contents. The hybrid nanocomposite films showed good antibacterial activity against Gram Nagative (*E-coli*) and Gram Positive (*S. aureus*) bacteria.

Keywords: Hybrid nanocomposite films; cellulose matrix; *in situ* generated silver nanoparticles; antibacterial activity; thermal properties; tensile properties.