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Abstract

Innovative Hydrogels with Silver Nanoparticles: Synthesis and Applications †

Katarzyna Sala [1,*], Magdalena Bańkosz [1,*], Anna Sobusiak [2], Claudia Garbowska [2], Magdalena Kędzierska [3] and Bozena Tyliszczak [1,*]

[1] Department of Materials Engineering, Faculty of Materials Engineering and Physics, Cracow University of Technology, 31-155 Kraków, Poland
[2] Department of Physics, Faculty of Materials Engineering and Physics, Cracow University of Technology, 31-155 Kraków, Poland; anna.sobusiak@student.pk.edu.pl (A.S.); claudia.garbowska@student.pk.edu.pl (C.G.)
[3] Department of Chemotherapy, WWCOiT Copernicus Hospital, Medical University of Lodz, 90-419 Łódź, Poland; kameleonmagda6@gmail.com
* Correspondence: katarzyna.sala@student.pk.edu.pl (K.S.); magdalena.bankosz@pk.edu.pl (M.B.); bozena.tyliszczak@pk.edu.pl (B.T.)
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Recent years have seen significant progress in the field of hydrogel materials, especially in terms of their modification with silver nanoparticles. A new method has been developed for producing hydrogels containing polyvinylpyrrolidone (PVP) and polyethylene glycol (PEG), modified with silver nanoparticles, using eco-friendly components. In the synthesis process, silver azide was used as a precursor for silver nanoparticles, and an extract from Plantago lanceolata, known for its reducing and stabilizing properties, was employed. Silver nanoparticles were incorporated into the PVP and PEG hydrogel matrix, creating a unique composition with enhanced properties. The obtained hydrogels demonstrated excellent antibacterial properties due to the presence of silver nanoparticles. Tests also confirmed their biocompatibility and structural stability. Additionally, the presence of the Plantago lanceolata extract contributed to the increased bioactivity of the hydrogels. The developed hydrogels have a wide range of applications, particularly in regenerative medicine, as wound dressings; in drug delivery systems; and in cosmetology. Their antibacterial and bioactive properties make them a promising material in modern biotechnology and medicine.

This study focused mainly on investigating the physicochemical and mechanical properties of the finished systems. Methods of the physicochemical analysis included UV–Vis spectrophotometry to evaluate the absorption of silver nanoparticles, as well as a sorption capacity analysis and incubation studies in simulated body fluids. A valuable analysis of surface morphology was carried out using a high-resolution digital microscope to determine surface roughness parameters. The comprehensive studies conducted provided important information on the material characteristics of the hydrogel, which is crucial for understanding the potential applications of these materials in biomedical practice.

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