materials proceedings

MDPI

Abstract

Silver Nanoparticles Formation and PVP Crosslinking Using UV-Radiation †

Stephanie Albino, Tânia Vieira * and Jorge Carvalho Silva

I3N-CENIMAT and Physics Department, School of Science and Technology, Nova University of Lisbon, 2829-516 Caparica, Portugal; stephanieealbino@gmail.com (S.A.); jcs@fct.unl.pt (J.C.S.)

* Correspondence: ts.vieira@fct.unl.pt

† Presented at the Materiais 2022, Marinha Grande, Portugal, 10–13 April 2022.

Keywords: silver nanoparticles; UV-radiation; polyvinylpyrrolidone

Silver nanoparticles (AgNPs) can be easily incorporated into wound dressings, exhibiting a broad range of antimicrobial activity, without possessing the acute cytotoxicity of ionic silver, and improving wound healing [1].

AgNPs can be produced using physical or chemical methods. In physical methods, energy is supplied to the Ag precursor in the form of heat or radiation, without using toxic reducing agents. Usually, a polymer is used to host the silver nanoparticles and act as stabilizers or surface capping agents. UV irradiation have been used to obtain cellulose acetate nanofibers [2] and polyvinylpyrrolidone (PVP) nanofibers [3] containing AgNPs on their surfaces.

In this work, we optimized the production of AgNPs using PVP as a stabilizing agent, $AgNO_3$ as the Ag source, and UV radiation as source of energy to produce the AgNPs and simultaneously to crosslink the PVP polymer.

Different parameters were evaluated: PVP concentration (16, 18, 20, 22 and 24 wt.%); water to ethanol solvent ratio (1:3, 1:1 and 3:1); PVP to $AgNO_3$ ratio (400:1, 200:1, 100:1 and 50:1); and irradiation time (15, 30, 60, 90, 120 and 150 min). The UV-Vis spectrum of each solution was acquired to evaluate the intensity of the absorption peak at 420 nm regarding the surface plasmon resonance of the AgNPs.

The results reveal that different conditions were able to induce the production of stable AgNPs but the highest production rate was obtained from the solution with 20 wt.% PVP dissolved in 1:1 water to ethanol ratio, with PVP to $AgNO_3$ ratio of 200:1 irradiated with UV. In addition, the obtained irradiated solution has the characteristics (viscosity and conductivity) adequate to be used in the electrospinning process to produce an antibacterial fibrous mat that can be used as wound dressing.

Author Contributions: Conceptualization, J.C.S.; methodology, J.C.S.; validation, J.C.S.; formal analysis, S.A. and T.V.; investigation, S.A. and T.V.; resources, J.C.S.; data curation, J.C.S.; writing—original draft preparation, S.A. and T.V.; writing—review and editing, J.C.S.; supervision, J.C.S.; project administration, J.C.S.; funding acquisition, J.C.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by FCT—the Portuguese Foundation for Science and Technology, I.P./MCTES through national funds (PIDDAC) and by the Regional Operational Program of Lisbon (FEDER), grant number PTDC/BTM-MAT/31470/2017 (iSkin2).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data generated during this work are available from the corresponding author upon reasonable request.

check for updates

Citation: Albino, S.; Vieira, T.; Silva, J.C. Silver Nanoparticles Formation and PVP Crosslinking Using UV-Radiation. *Mater. Proc.* **2022**, *8*, 86. https://doi.org/10.3390/materproc2022008086

Academic Editors: Geoffrey Mitchell, Nuno Alves, Carla Moura and Joana Coutinho

Published: 8 June 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Tian, J.; Wong, K.K.; Ho, C.M.; Lok, C.N.; Yu, W.Y.; Che, C.M.; Chiu, J.F.; Tam, P.K. Topical delivery of silver nanoparticles promotes wound healing. *ChemMedChem* **2007**, *2*, 129–136. [CrossRef] [PubMed]
2. Son, W.K.; Youk, J.H.; Park, W.H. Antimicrobial cellulose acetate nanofibers containing silver nanoparticles. *Carbohydr. Polym.* **2006**, *65*, 430–434. [CrossRef]
3. Rosa, R.M.; Silva, J.C.; Sanches, I.S.; Henriques, C. Simultaneous photo-induced cross-linking and silver nanoparticle formation in a PVP electrospun wound dressing. *Mater. Lett.* **2017**, *207*, 145–148. [CrossRef]