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# Synthesis and Characterization of Electrospun Poly(vinyl pyrrolidone) (PVP) and Poly(vinyl alcohol) (PVA) Nanofibers with Au Nanoparticles

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Electrospinning is an electrical, jet-based method of fabricating nanofibers that involves the application of a very high electrostatic force on the capillary containing the polymer solution or polymer-melt. The fibers are created by an electrically charged jet of the polymer solution, which can be collected on the surface of a grounded template. The incorporation of metal nanoparticles produces functional nanofibers. Among the noble metal nanoparticles, gold nanoparticles are promising because they have electronic, magnetic, optical and catalytic properties [1].

The solution for electrospinning poly(vinyl pyrrolidone) (PVP) nanofibers was prepared by mixing varying concentrations of 10 nm Au nanoparticles-colloidal solution and PVP (average M.W. 1,300,000) in isopropyl alcohol (IPA). The electrospinning was carried out at 15 kV to produce non-woven mats of fibers with diameters ranging from 85 nm to 1 μm. Using a Hitachi H-7000 FA TEM, we could confirm the presence of Au nanoparticles within the amorphous PVP matrix (Fig. 1A and 1B). The distribution of Au nanoparticles in the PVP fibers was completely random.

Au/PVA nanocomposite films were prepared by using colloidal solution of Au nanoparticles and poly(vinyl alcohol) (PVA) (average M.W. 72,000) as precursors. A colloidal solution of 0.91 mM Au was prepared [2]. Direct mixing of 1 ml of 5 mass% aqueous PVA solution with 12 ml of 0.91 mM Au colloidal solution lead to formation of stable transparent PVA/Au dispersion. The mixture was placed in a Petri dish and dried in air. After solvent evaporation, a transparent, 4.1 wt% Au/PVA film was obtained. PVA nanofibers with Au nanoparticles were prepared by electrospinning a solution made by dissolving the PVA thin films containing Au nanoparticles, with average diameters ranging from 15 nm to 30 nm, in $H_2O$ and IPA, with additional PVA (average M.W. 85,000-124,000). The solution was electrospun at 15 kV to produce PVA nanofibers embedded with Au nanoparticles (Fig. 2A and 2B). Energy-dispersive X-ray spectrometry (EDX) was done to confirm the presence of Au nanoparticles (Fig. 3). Such nanocomposite fibers are of interest as self-assembled templates for bottom-up fabrication methodologies [3].

References

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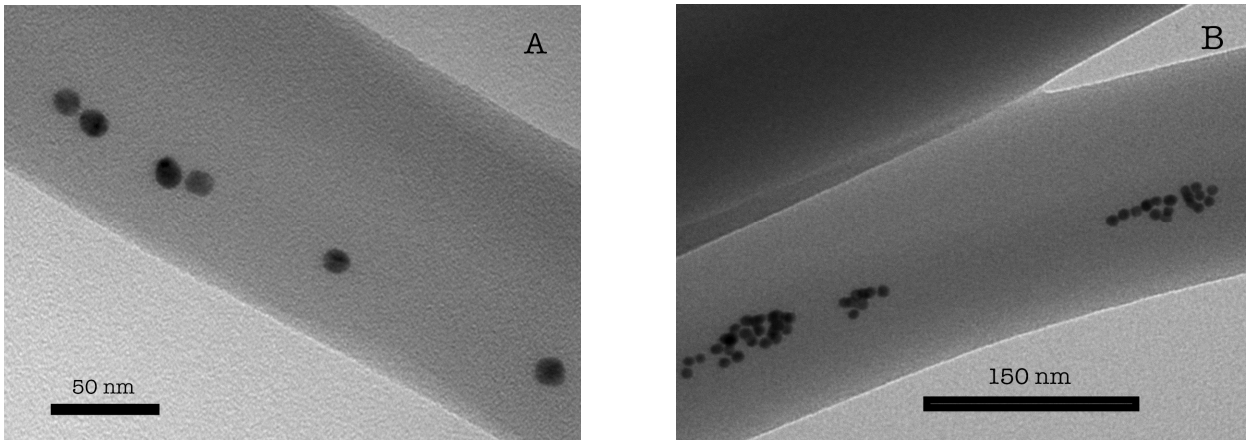


FIG. 1. (A) and (B) TEM images of electrospun PVP nanofibers with Au nanoparticles. The ratio of IPA to Au-colloid was 5. Electrospinning was done at 15 kV.

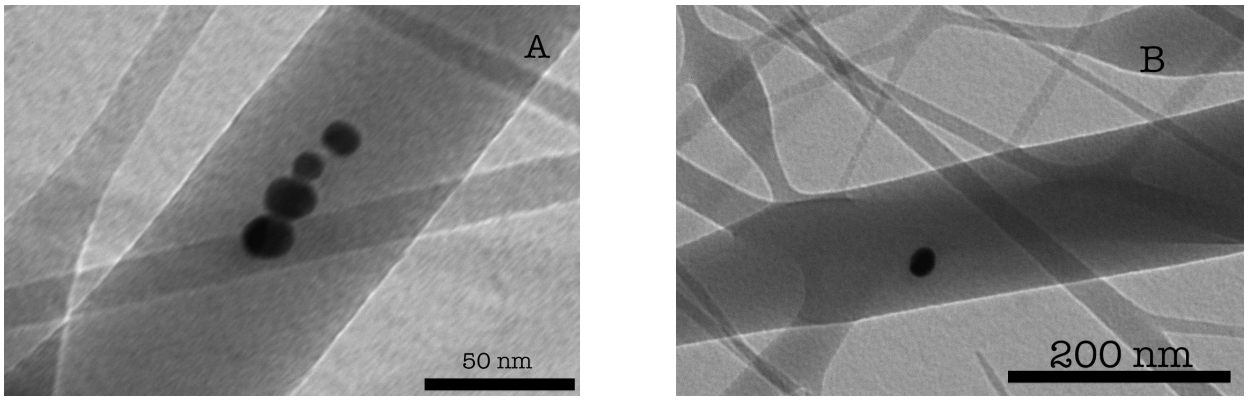


FIG. 2. (A) and (B) TEM images of electrospun PVA nanofibers with Au particles embedded. The solution was prepared by dissolving Au/PVA nanocomposite films in $H_2O$ and IPA. Electrospinning was done at 15 kV.

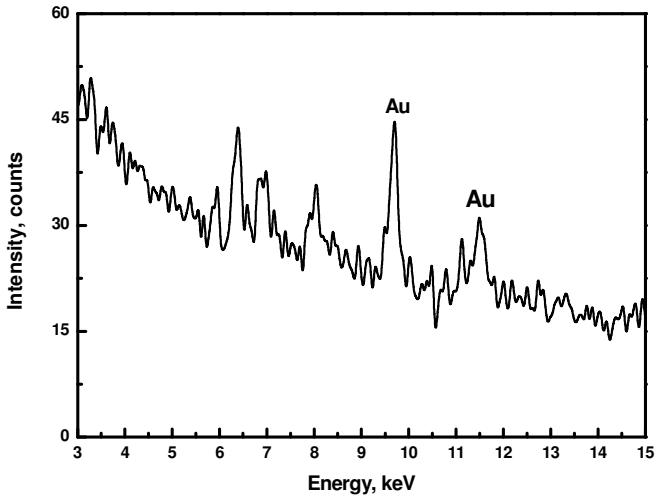


FIG. 3. EDX spectrum taken from Au/PVA electrospun nanofibers showing the presence of Au.

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