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A FACILE METHOD FOR SYNTHESIZING PVA/Au, PVA/Ag AND PVA/AuAg NANOCOMPOSITES

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Summary: Recently, hydrogels containing metal nanoparticles (NPs) have attracted much attention in the biomedical field. In particular, hydrogels containing AgNPs have been deployed widely in antibacterial applications including wound dressing and implant coatings, and hydrogels containing AuNPs have been commonly deployed in drug delivery systems and cancer therapies, etc. However, despite the recent advances in this field, very few attempts have been made towards one-step fabrication of multi-functional bio-nanocomposites. In addition, fabrication of green biocomposites with controlled nanoparticle size, distribution and dispersion (therefore controlled functionality) still remains a challenge in achieving safe, environmentally friendly and cost effective healthcare devices.
In this paper, we presented a facile way of preparing PVA/Au, PVA/Ag and PVA/AuAg nanocomposites through in situ synthesis of metal nanoparticles in PVA hydrogel network using a room temperature atmospheric pressure microplasma. This is the first attempt of deploying microplasma technology in the fabrication of hydrogel/metal NP based composites. The proposed method is rapid (process can be completed within minutes), green (eliminates toxic reducing chemicals), and energy efficient (no heating involved). The materials synthesized have been fully characterized for UV-vis, FTIR, TEM as well as their mechanical strengths. The nanoparticles synthesized within the PVA hydrogel network are found to be well dispersed, and the size and shape of the nanoparticles are dependent on the metal salt precursor concentration and plasma processing parameters. The nanocomposites synthesized from this work may have potential applications in various areas, in particular, the hydrogel containing Ag/Au biometallic nanoparticles can achieve multi-functionalities including antibacterial, drug carrier, sensing, imaging, cancer diagnostics and treatment, etc. Moreover, we believe our approach has opened a new avenue towards multi-scale synthesis of green and multi-functional nanocomposites. Although the current study has focused on a conventional hydrogel material, we are confident that the technology can be generalized and expanded into a wide range of nanoparticle/polymer systems, where the long standing challenge of nanofiller agglomeration may be tackled, and a much enhanced functionality of the resulting nanocomposites can be expected in various practical applications.