Silver nanoparticle loaded antibacterial polymer mesh using plasma polymerization process

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Some specialized applications of polymers include biomedical devices and healthcare products made of various forms of polymers. For example, patches in the form of fabric meshes made of synthetic polymeric material are being widely used as support to repair hernias in a surgical procedure. These support polymer patches are sewn over the weakened area in the abdominal wall after the hernia is pushed back into place. The support mesh decreases the tension on the weakened abdominal wall, reducing the risk of hernia recurrence [1]. Prevention of adsorption and growth of micro-organisms on polymer surfaces is prerequisite for the biomaterials to prevent the post-surgical infections. However, synthetic or natural polymers themselves do not have intrinsic antibacterial properties. One way to circumvent this drawback is to coat the polymer with silver nanoparticles which cumulate the well known antibacterial properties of silver and structural properties of nanoparticles, whose large specific surface area as compared to conventional materials allows a small concentration of silver nanoparticles dispersed to the polymeric substrate to exhibit an excellent antimicrobial efficacy [2].

This work reports on the use of plasma processing for incorporation of silver nanoparticle on polyethylene terphtalate (PET) mesh in order to achieve antibacterial property. Polyacrylic acid was polymerized on to polymer substrate by Plasma Enhanced Chemical Vapour Deposition (PECVD) process to introduce carboxylic groups, which act as the anchor for silver nanoparticles synthesized by chemical reduction method using $NaBH_4$. Plasma polymerized acrylic acid (PPAA) chains acts as a capping agent as well as stabilizing agent for the silver nanoparticles. Silver nanoparticles loaded polymer samples were characterized by UV-visible spectroscopy, field emission scanning electron microscopy (FESEM), energy dispersive x-ray (EDX) and XPS techniques, showing the presence of ~1.0 at. % of silver nanoparticles composed of 79% zero-valent (Ag^o) and 21% oxidized nano-Ag (Ag^+). The plasma processed PET meshes samples were tested for antibacterial activity against two bacterial strains, *Staphyloccocus aureus* (Gram positive bacteria) and *Escherichia coli* (Gram negative bacteria). Qualitative and quantitative tests showed that silver containing PPAA-PET meshes exhibit excellent antibacterial property against the tested bacteria with percent reduction of bacterial concentration >99.7%, compared to the untreated PET mesh.

[1] Chastan P. Int. Surg. (2005), **90**, 48-52
[2] Lee H. J., Yeo S. Y, Jeong S. H., J. Mater. Sci. (2003), **38**, 2199 – 2204.