Surface-Engineering of Poly(ethylene terephthalate)(PET) for Durable Haemocompatibility via a New Surface Interpenetrating Network Technique

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Cardiovascular diseases (CVD) remain the number one cause of mortality globally and often necessitate surgical intervention with bypass grafts. Bypass grafts can be either autologous (made from the patient's own tissue) or synthetic. Autologous vessels are difficult to harvest and their supply is heavily dependent on the patient. Compared with autologous vessels, synthetic vascular grafts such as poly(ethylene terephthalate) (PET) vascular grafts are widely used to replace or bypass diseased arteries. However, synthetic vascular grafts are susceptible to thrombosis when in contact with blood. Therefore, the haemocompatibility of prosthetic vascular grafts should be improved.

The purpose of this research is to fabricate a durable and haemocompatible material that could be applied to vascular grafts by using a surface modification technique. Based on the formation of the special surface interpenetrating network, a bioactive agent, heparin, was covalently bonded to chemically inert PET substrate. Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Photoelectron Spectroscopy (XPS) spectra confirmed the successful heparinization of PET (PET-Hep). The density of surface-immobilized heparin as quantified by a colorimetric method could reach 2.4 μg cm^{-2} (in the reported optimal range: 1.5 - 3.0 μg cm^{-2}). The haemocompatibility of the heparin-immobilized PET was improved as evidenced by a platelet adhesion test: significantly less platelet adhesion on PET-Hep (11.60%) than on untreated PET (48.91%). An MTT assay indicated PET-Hep was nontoxic to human dermal fibroblast cells. After immersing in PBS buffer solution for 24 hours, 94.76% of heparin stayed on PET-Hep. The heparin engineered PET substrate holds the potential to be used in small-diameter vascular grafts in the long term.