catheters in comparison to the urine collected after use of the gel-lubricated catheter. Finally, upon questioning the patients undergoing catheterization, 93% of participants preferred the hydrophilic-coated catheters (Stensballe et al. 2005). The relatively rapid dry out and ready detachment of most currently-available hydrophilic coatings from the device surface means that, in practice, the surface is often in a dried out or uncoated state during removal of the device, causing much pain and damage to the urethra from the resulting frictional forces (Stensballe et al. 2005).

Multifunctional Coatings

Optimal performance of many medical devices requires a combination of the previously described surface properties. For example, surfaces of blood-contacting medical devices should ideally resist bacterial adhesion, but not at the expense of their inherent haemocompatibility. Multilayer hydrogel coatings exhibiting a desirable combination of antibacterial and athrombogenic properties have recently been developed from silver nanoparticle-containing poly(ethylene glycol) (PEG)-heparin hydrogel films. An outer silver-free hydrogel coating on the silver-loaded PEG-heparin hydrogel layer performs the dual role of shielding mammalian cells from the silver nanoparticles, while also serving as a diffusion barrier for prolonged bioactive release (Fischer et al. 2015).

Orthopaedic devices, in particular, have a dual requirement to integrate within the bone while also remaining resistant to bacterial colonization. This balance can be challenging to achieve on the basis of the similar mechanisms of cellular surface adhesion between host tissue cells and infecting bacterial cells. Surface modifications which reduce bacterial adherence are therefore often detrimental to the process of host tissue integration, and vice versa (Goodman et al. 2013). For example, the addition of antibacterial agents to the biomaterial can have undesirable effects on host tissue cells, while also compromising the mechanical performance of the device itself. Chitosan, however, is a biocompatible polysaccharide with antibacterial activity deriving from the presence of a cationic amino group which targets bacterial cell membranes. Materials based on this biocompatible polysaccharide have, in addition, demonstrated the ability to enhance host cell adhesion and proliferation (Gaharwar et al. 2010). Of relevance here is the synthesis of chitosan-gentamycin sulfate hydrogels as candidate orthopaedic coatings which both reduce infection and improve osteogenic activity. These materials successfully inhibited biofilm formation while also stimulating the adhesion, proliferation and differentiation of MC3T3-E1 osteoblast cells during an *in vitro* study (Meng et al. 2014).

The development of dual lubricious and bacterial-repelling urinary catheter surfaces represents a promising strategy to both improve patient comfort and prevent unwanted complications, namely urinary infections and associated cases of catheter encrustation and blockage. With up to 80% of all nosocomial urinary infections resulting from the implantation of indwelling urinary catheters (Nicolle 2010), and treatment complicated by the nature of bacterial growth within highly regulated biofilm communities (Tambyah and Oon 2012), there is an urgent need for effective solutions to prevent catheter-associated urinary tract infections.