Dual functional ionic liquids as plasticizers and antimicrobial agents for medical polymers

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Polyvinyl chloride(PVC) is widely used in many applications, including medical devices.However,the presence of phthalate esters as plasticizers in PVC has raised the concern of posing health risks in human with suspected reproductive and developmental toxicity.Although the adverse effect of phthalates on humans are uncertain,the possible hazard would make preterm infants and dialysis patients particularly vulnerable.On the other hand,PVC catheters often face the problem of catheter-related infections and biofilm formation caused by Staphylococcus epidermidis,which results in implant-failures and increased healthcare cost,thus posing an enormous threat to personal and public health. To overcome these problems,dual functional ionic liquids possessing both plasticizing and antimicrobial properties were designed to replace phthalates in PVC.Ionic liquids(ILs) are nonmolecular organic salts with low melting points,thus giving the physical appearance of a liquid at low temperature.They have been regarded as ‘green’ due to their nonvolatility,whilst their high versatility allows specific tailoring of properties.Two ILs,1-ethylpyridinium docusate(IL1) and tributyl(2-hydroxyethyl)phosphonium docusate(IL2) were synthesized and processed with PVC using conventional melt-extrusion techniques.It was found that both ILs showed significant plasticizing and antimicrobial effects.PVC-IL1 composites showed reduction of glass transition temperature(Tg) of 9^0C while PVC-IL2 composites showed a 42^0C reduction in Tg at 30wt% IL addition relative to the neat PVC compound.Incorporation of both ILs also showed antimicrobial effect towards tested Gram-positive bacteria,especially MRSA and biofilm-forming Staphylococcus epidermidis,which is a major cause for catheter-related infections.PVC-IL1 composite with 10wt% IL1 addition inhibited growth of clinically isolated biofilm-forming Staphylococcus epidermidis by up to 98%.Thermal stability of these composites was also investigated.