SURFACE CHEMICAL ANALYSIS OF POLYMERIC CONTROLLED RELEASE SYSTEMS

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A knowledge of the surface chemical composition is important in the characterisation of pharmaceutical dosage forms both in terms of drug release rates and polymer biocompatibility. Previous work has illustrated the high potential of static secondary ion mass spectrometry (SSIMS) for the characterisation of the surface chemical state of polymers and polymeric drug delivery systems employed in controlled drug delivery (Davies and Brown, 1986). SSIMS is a sophisticated applied surface analysis technique which is sensitive to the uppermost surface layer yielding not only elemental composition but also the chemical structure, ie functional groups, of the polymer surface. This study reports on the application of SSIMS to the determination of the surface orientation of model drug, protein and peptide molecules (cimetidine, albumin and cyclosporin respectively) within a model polymeric film system, hydroxypropylmethylcellulose (HPMC).

The drug/protein/peptide laden polymer films were prepared by solvent evaporation to a thickness of approximately 1 mm. SSIMS spectra of these films were obtained with a VG SIMSLAB instrument and the detailed experimental procedure has been described previously (Davies and Brown, 1985). For reference purposes, standard SSIMS spectra of cimetidine, albumin, cyclosporin and HPMC were obtained from pure, thin (< 100 uM) films cast from an aqueous solution onto an aluminium substrate.

The standard positive and negative ion spectra of the polymer and drugs show ions which are readily interpretable using standard EI mass spectrometry rules and are characteristic of the chemical structure of the molecules. The SSIMS spectra of the HPMC film yield ions which are diagnostic of the substitution of the hydroxypropyl (59 daltons) and methoxyl (45 daltons) functional groups on the cellulose backbone. Similar findings were deduced from the negative ion spectra, confirming the potential of SSIMS for the production of "fingerprint" spectra for the surface chemical composition of biopolymeric materials (Davies and Brown, 1986). The surface analysis of the polymer-drug film formulation clearly demonstrates the presence of the molecular ion, and the principal fragmentation ions of cimetidine in both positive and negative ion SSIMS spectra. Similar results were obtained for the albumin and cyclosporin where diagnostic fragmentation ions permit the elucidation of the surface orientation within the polymer surface.

This study provides further evidence that sophisticated surface analysis techniques such as SSIMS are powerful tools to be employed in the future design, optimisation and characterisation of a possible wide range of advanced polymeric drug delivery systems.

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