Controlling Burst and Final Drug Release Times from Porous Polylactide Devices Derived from Co-Continuous Polymer Blends

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This work has demonstrated that it is possible to exercise a wide range of control over both the initial burst release and the final drug release times from porous polylactide (PLA) devices derived from co-continuous polymer blends. Two strategies were used, a layer-by-layer polyelectrolyte surface deposition approach on the porous PLA surface and the application of a partially closed-cell protocol. A PLA porous substrate with a pore-size of 1.5 μm, derived from a blend of PLA and polystyrene (PS) via selective solvent extraction of the PS phase, was used as the drug delivery device. The surface area and pore dimensions were examined via BET nitrogen adsorption and image analysis. Porous PLA substrates with 0, 3 and 5 layers of polyelectrolyte and with open areas of 100%, 12 % and 2% were studied both separately and in combination. In vitro release tests were performed to study the release profile of bovine serum albumin (BSA) from the devices via UV spectrophotometry. It is shown that, while both are important, surface modification is more dominant in controlling the release rate than the partially closed cell approach. When a 5 polyelectrolyte layer surface modification of the PLA and a partially closed cell approach (2 % open area) are combined, in the L5C sample, the synergy is dramatic with a 5 times reduction in the first two hour burst release amount and a total release time which is extended by 123 times as compared to the 100% open cell, surface unmodified, reference sample. The L5C sample ultimately releases 89% of the total BSA loaded demonstrating the high level of interconnectivity of the micro channels in the porous PLA. The mechanism of release in this system is clearly diffusion controlled with well defined concentration gradients, as measured by X-ray Photoelectron Spectroscopy (XPS).