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Funding Source: NSF Functional Materials REU

Photolytically-controlled release of dexamethasone

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Current medical procedures used for repairing bone injuries offer support and stabilization to compromised bones but do not offer a method capable of encouraging bone regeneration. Tissue engineering offers a method of promoting bone regeneration; specifically, we are interested in using tissue engineering to differentiate MSCs into osteoblasts for bone repair. Dexamethasone (dex) has been found to differentiate mesenchymal stem cells (MSCs) into bone-cells, osteoblasts, and we want to control delivery of dex within a tissue engineering scaffold PEG hydrogel. Further, controlled release of dex is important because specific release rates and concentrations (100 nM) are required for the differentiation of MSCs. [1] Externally-controlled release via photolytically labile tethers is beneficial for high-throughput screening of the effect of Dex release on MSCs at differing rates and concentrations. In particular, photolytic release provides control temporally for turning the release on or off with light exposure and tailoring the release rate with light intensity in addition to providing control spatially for location-specific release via photolithography. Here, we used varying light intensities to demonstrate the temporal control granted by using a photolytically labile molecule. Prior to this, we characterized the diffusion of dex within our hydrogel network. Our experiments demonstrated that we could achieve controlled release of dex wih varying light intensity and it should thus be possible to achieve the required 1 week delivery of dex with a low light intensity. On the other hand we observed that using a hydrogel with dex encapsulated would only deliver dex for a matter of hours. For this reason, encapsulation of dex is not a viable option for the differentiation of MSCs. In the future, it is possible that spatial control could be demonstrated by using light to target localized sections of a gel for releasing dex only from those locations.