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PII: S0168-3659(18)30370-5
DOI: doi:10.1016/j.jconrel.2018.06.022
Reference: COREL 9346

To appear in: *Journal of Controlled Release*

Received date: 18 April 2018
Revised date: 14 June 2018
Accepted date: 14 June 2018

Please cite this article as: Deniz Ceylan Tuncaboylu, Fabian Friess, Christian Wischke, Andreas Lendlein , A multifunctional multimaterial system for on-demand protein release. Corel (2018), doi:10.1016/j.jconrel.2018.06.022

A multifunctional multimaterial system for on-demand protein release

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ABSTRACT

In order to provide best control of the regeneration process for each individual patient, the release of protein drugs administered during surgery may need to be timely adapted and/or delayed according to the progress of healing/regeneration. This study aims to establish a multifunctional implant system for a local on-demand release, which is applicable for various types of proteins. It was hypothesized that a tubular multimaterial container kit, which hosts the protein of interest as a solution or gel formulation, would enable on-demand release if equipped with the capacity of diameter reduction upon external stimulation. Using devices from poly(ε-caprolactone) networks, it could be demonstrated that a shape-memory effect activated by heat or NIR light enabled on-demand tube shrinkage. The decrease of diameter of these shape-memory tubes (SMT) allowed expelling the payload as demonstrated for several proteins including SDF-1α, a therapeutically relevant chemotactic protein, to achieve e.g. continuous release with a triggered add-on dosing (open tube) or an on-demand onset of bolus or sustained release (sealed tube). Considering the clinical relevance of protein factors in (stem) cell attraction to lesions and