Optoregulation of 3D cellular microenvironments

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Light-responsive hydrogels are promising platforms to mimic the dynamic properties of natural cellular microenvironments and investigate cellular processes and responses to physiological and pathological changes. Reported examples mainly deal with the incorporation of photocleavable chromophores to change the mechanical, chemical and topological properties of hydrogels upon light exposure both in 2D and 3D cell cultures using well established o-nitrobenzyl chemistry. A major limitation of this group for realizing microenvironment changes in situ with 3D resolution is its poor two-photon absorption cross-section, leading to cell photodamage and loss of function.
We present new biocompatible hydrogel designs that allow 3D patterning of areas with distinct adhesive ligands upon light exposure in the presence of cells. The gels contain ligands modified with two-photon sensitive chromophores and have initially no activity. Upon laser scanning, the chromophore is removed and the ligand becomes activated at selected positions within the gel. Site-selective activation allows us to define patterns with specialized areas within the gel and guide the regeneration of patterned tissues.

[1] L. G. Fernandez and A. del Campo et al. Adv. Mater. 26, 5012 (2014).

[2] T. T. Lee, A. del Campo and A. J. García et al. Nature Materials 14, 352 (2015).

[3] M. J. Salierno and A. del Campo et al, Adv. Funct. Mater. 23, 5974 (2013).

[4] K.M. Schelkle, T. Griesbaum, R. Wombacher, Angew. Chem. Int. Ed. 54, 2825 (2015).