Materials to Study Biology in 4D: Photoresponsive hydrogels to study and direct the growth of intestinal organoids

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This talk will illustrate our recent efforts in the design of hydrogel networks for 4D cell culture and regenerative medicine, and highlight photochemical click reactions that allow for spatiotemporal control of the biochemical and biophysical properties of cell-laden matrices. One specific example will demonstrate the design of photoadaptable, allyl sulfide functionalized poly(ethylene glycol) hydrogels for the growth of intestinal organoids (IOs), and the subsequent application of photopatterned light to locally alter epithelial curvature, initiate symmetry breaking events, and ultimately direct cell fate (Figure 1)[1]. These studies are then complemented by the development of new materials and methods for expansion microscopy, which enable optical clearance and super-resolution imaging of IOs and their ECM in 3D[2]. Finally, these efforts will be placed in the context of designing precision biomaterials to address demands for patient specific products and treatments.

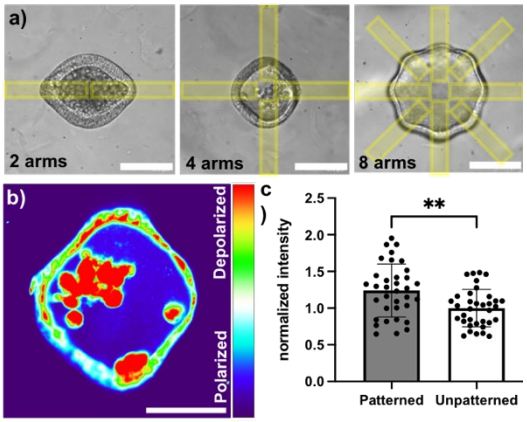

Figure 1. Allyl sulfide mediated control over epithelial shape. **(a)** Photoinduced relaxation of matrix forces enables modulation of epithelial shape. Coordinated transformations in epithelial shape lead to differences in membrane tension and resting membrane potential **(b)** within patterned regions **(c)**. Scale bars 50 μm.

[1]Yavitt,, F.M., Kirkpatrick, B.E. *et al.* **2023**, doi.org/10.1126/sciadv.add5668 *Science Advances*.
[2]Blatchley, M.R., Günay, K.A. *et al.* **2022,** 2190252, *Advanced Materials.*