**Shape-morphing living composites**

Laura K. Rivera-Tarazona1, Vandita D. Bhat, Zachary T. Campbell and Taylor H. Ware1\*

1 Department of Bioengineering, The University of Texas at Dallas, Richardson, Texas, USA

2 Department of Biology, The University of Texas at Dallas, Richardson, Texas, USA

Nature offers a wide variety of materials that dynamically transform shape in response to specific environmental changes. These properties have triggered incredible interest in mimicking the behavior of living organisms in synthetic materials. A number of classes of smart materials have been developed that use physical or chemical cues, such as changes in temperature or pH, to modify materials properties including shape. However, these stimuli are not specific to the material and may affect various components of the surrounding environment1. Here we use genetic engineering to create living composites capable of responding to pre-determined and specific stimuli. Specifically, we present a new method to create programmable shape-morphing living composites using polyacrylamide hydrogels that encapsulate *Saccharomyces cerevisiae* yeastcells. Proliferation of these microorganisms causes the macroscopic shape of the polymer matrix to change (volume expansion up to 300%). As the composite only changes shape in the presence of an appropriate growth media, composites that sense and respond to change in glucose concentration or the presence of an essential amino acid can be fabricated. Moreover, we utilize optogenetic tools to regulate DNA transcription upon light illumination in modified yeast cells. The integration of these cells with hydrogels allows the controlled growth of yeast using blue light to induce protein expression in cells and pattern shape change in the material. These tools enable precise and directional control of shape-morphing structures with potential applications in tissue engineering, sensing and drug delivery systems.

References:

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\* Author for Correspondence: taylor.ware@utdallas.edu