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Impact of Hydrogel Structure and Composition on Autonomic Chemo-Mechanical Behavior RYAN KRAMB, PHILIP BUSKOHL, UES, Dayton, OH, RICHARD VAIA, AFRL/RX, Materials and Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson AFB, OH — Autonomic materials harvest energy to change size, shape, or color in response to a set of environmental conditions. At the core of this biomimetic behavior is a material that transduces energy between forms (e.g. chemical to mechanical). The most widely studied of these materials are self-oscillating, Ru-containing PNIPAAm hydrogels driven by the Belousov−Zhabotinsky (BZ) reaction; and if correctly designed, BZ gels mimic biological process such as a quorum sensing or beating like a heart. However, establishing relationships between chemo-mechanical response and gel characteristics, such as crosslinking density, monomer composition, catalyst content, and gel stiffness, has remained elusive due to the limited material set and challenges in determining the appropriate balance of reaction kinetics and mechanical response necessary to establish self-sustaining oscillations. To address this challenge, we have broadened the suite of available monomers through a modular synthesis of the Ru-containing constituent; and thereby demonstrating facile tuning of the aforementioned characteristics of the BZ gel. From the resulting correlations between gel properties and chemo-mechanical response, we discuss the material design of composite autonomic gels for maximum shape change, directionality of oscillations, and synchronization of oscillations analogous to a natural pacemaker cell cluster.

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