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Bacillus spores as building blocks for stimuli-responsive materials and nanogenerators[1] OZGUR SAHIN, XI CHEN, Columbia University — Materials that mechanically respond to external chemical stimuli have applications in a wide range of fields. Inspired by biological systems, stimuli-responsive materials that can oscillate, transport fluid, mimic homeostasis, and undergo complex changes in shape have been previously demonstrated. However, the effectiveness of synthetic stimuli-responsive materials in generating work is limited when compared to mechanical actuators. During studies of bacterial sporulation, we have found that the mechanical response of Bacillus spores to water gradients exhibits an energy density of more than 10 MJ/m3, which is two orders of magnitude higher than synthetic water-responsive materials. We also identified mutations that can approximately double the energy density of the spores, and found that spores can self-assemble into dense, submicron-thick monolayers on substrates such as silicon microcantilevers and elastomer sheets, creating self-assembled actuators that can remotely generate electrical power from an evaporating body of water. The energy conversion mechanism of Bacillus spores may facilitate synthetic stimuli-responsive materials with significantly higher energy densities.

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