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Cutting and Folding for Tunable Materials Properties[1] PABLO DAMASCENO, Applied Physics Program, University of Michigan, PAUL DODD, Department of Chemical Engineering, University of Michigan, TERRY SHYU, Materials Science and Engineering, University of Michigan, MATTHEW SHLIAN, School of Art and Design, University of Michigan, MAX SHTEIN, Materials Science and Engineering, University of Michigan, NICHOLAS KOTOV, SHARON GLOTZER, Department of Chemical Engineering, University of Michigan — Despite the small set of building blocks used for their assembly, naturally occurring materials such as proteins show remarkable diversity in their mechanical properties ranging from something resembling rubber–low stiffness, high resilience and extensibility–to silk–high stiffness and strength. Moreover, their self-folding properties inspire the design of structures capable of tunable reconfiguration. Motivated by such versatility, we report on simulations and experiments for the design of nanocomposites sheets whose mechanical properties can be made tunable via "secondary structures" patterning. Our simulations reveal the main cutting features needed to obtain desired material extensibility. Additionally, we study how similar sheets could self-fold into their desired "native" structure via stochastic forces. Our results open the possibilities for manufacture of flexible and reconfigurable materials with targeted strength and extensibility.

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