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Mechanics and geometry in the seashell-like (Turritella) surface QIAOHANG GUO, ZI CHEN, Washington University in St. Louis, WEI LI, KUN REN, JUNJIE LIN, Fujian University of Technology, LARRY A. TABER, Washington University in St. Louis, WENZHE CHEN, Fujian University of Technology — Helical structures are ubiquitous in nature and engineering, ranging from DNA molecules to plant tendrils, from sea snail shells to nanoribbons. While the helical shapes in natural and engineered systems often exhibit nearly uniform radius and pitch, helical shell structures with changing radius and pitch, such as seashells and some plant tendrils, adds to the variety of this family of aesthetic beauty. Here we report the first biomimetic seashell-like structure resulting from mechanics of geometric frustration. In previous studies, the total potential energy is everywhere minimized when the system achieves an equilibrium. In this study, however, the local energy minimization cannot be realized because of the geometric incompatibility, and hence the whole system deforms into a shape with a global energy minimum whereby the energy in each segment may not necessary be locally optimized. This novel approach can be applied to develop materials and systems with desirable geometries by exploiting mechanics of geometric frustration. The authors would like to thank Yushan Huang, Zhen Liu, Si Chen for their assistance in the experimental demonstration. This work has been in part supported by NSFC (Grant No.11102040 and No.11201001044), the Sigma Xi Grants-in-Aid of Research (GIAR) program, American Academy of Mechanics Founder's Award from the Robert M. and Mary Haythornthwaite Foundation, and Society in Science, The Branco Weiss Fellowship, administered by ETH Zurich. Qiaohang Guo and Zi Chen contributed equally to this work.

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