Tailorable Polymeric Building Blocks for 3D Collective Assembly via internal Stress Engineering

조웅비[1,2], 위정재[1,3,†]
[1]인하대학교; [2]고분자환경융합공학과; [3]고분자공학과
(wie@inha.ac.kr[†])

In nature, many hierarchical structures are constructed by collective assembly of several building blocks. Repetitive-assembled building blocks generate scaled-up geometries consisted with regular fractal structures. Herein, tailorable 3D building blocks are photopolymerized via controlling internal stress for rapid and reproducible preparation. The photoabsorber generates an internal stress gradient through thickness governed by Beer-Lambert law, resulting in mismatch of shrinkage and resultant shape-morphed monolithic 3D structure. The building blocks are tailored by systematically changed spatiotemporal fabricating conditions including pre- and post-curing methods and geometry of 2D patterns adopted fractal elements such as symmetry and self-similarity. Inspired by design of famous architectures, hierarchical 3D structures are demonstrated by collective assembly of 3D building blocks. In addition, regularly stacked geometry allows 3D assembled structure to withstand 150 times of own weight by homogeneous distribution of normal stress. Finally, the potential applicability for electronic devices is demonstrated by coating a conductive material onto collective-assembled structure.