SHAPE MEMORY POLYURETHANE NANOCOMPOSITE FOR BONE REPAIR

Jinlian Hu*[1,2,] Yuanchi Zhang[1]

[1] Institute of Textiles and Clothing, The Hong Kong Polytechnic University, Hong Kong., 999077, China; jin-lian.hu@polyu.edu;
[2] Intelligent polymer of biomedical materials research centre, Shen Zhen Base, The Hong Kong Polytechnic University, Shen Zhen, 518057, China

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ABSTRACT

Overall high-performance shape memory polymer composites (SMCs) are desired in diverse fields while a stubborn conflict between mechanical and memory properties impedes their development in applications such as bone repair for high load-bearing locations' defects and minimally invasive surgery. For achieving a SMC with coalesced high performances in both shape memory and mechanical properties simultaneously, we here report a novel "trampoline" polyurethane nanocomposite based on the modification sequence of graphene oxide in the composite fabrication process, which can tune interlayer spacing. Two nanocomposites with different GO modification sequences were designed: an oligomer modified GO was prepared first and employed for synthesizing the SMC (omG-SMC) with larger interlayer spacing while an isocyanate modified GO was fabricated, then used to produce the SMC (imG-SMC) with shorter interlayer spacing. In this work, an intercalating structure with spring-like support, trampoline model, is proposed and was carefully examined. It is found that with larger interlayer spacing, namely taller spring support, with a longer molecular chain between two-dimensional sheets, the "trampoline" structure can remarkably improve memory and mechanical properties jointly. As desired, both high mechanical and good memory properties, e.g. ~456.72MPa of Young's modulus and ~100% of shape recovery ratio, were attained respectively for the SMC. A minimally invasive bone-repairing example then demonstrated an ideal support performance for bone regeneration through finite element analysis, which showed the highest stress distributed around the implant particularly at the interface, which is essential for effective bone tissue regeneration. This "trampoline" nanocomposite paves a bright way to design and prepare SMCs with advanced performances for broad applications.