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Ultra-strong, Tough and High Wear Resistance High-density Polyethylene for Structural Engineering Application: A Facile Strategy Towards Using the Combination of Extensional Dynamic Oscillatory Shear Flow and Ultra-high-molecular-weight Polyethylene

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Abstract: General purpose plastic materials with high strength and toughness are in great demand for structural engineering applications in recent years. Inspired by the relationship of excellent integration of mechanical performance and hierarchically ordered shish-kebab structure of polymeric materials, a facile and efficient strategy based on the combined effect of strong extensional dynamic oscillatory shear flow and ultra-high-molecular-weight polyethylene (UHMWPE) was developed to fabricate ultra-strong, super-tough and high wear resistance integrated high-density polyethylene (HDPE)-based materials. As a result, the maximum value of tensile strength, modulus and toughness were respectively 3.8, 5.9 and 6.8 times higher than that of neat HDPE, even superior to that of most common engineering plastics. Meanwhile, the wear rate of resultant HDPE-based materials could be reduced from 18.6 to 4.2 mg/MC. Overall, the HDPE-based material with extraordinary integrated strong, tough and high wear resistance properties would have a great potential for the replacement of engineering plastics and application in aerospace, military, tissue engineering, *etc.*

Keywords: Polymers; Structural composites; Fracture toughness; Friction/wear; Strength.

Introduction

Improving strength, modulus and toughness of high-density polyethylene (HDPE) materials, one of the most common used general purpose plastic, has always been an important topic in the field of plastic industry

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