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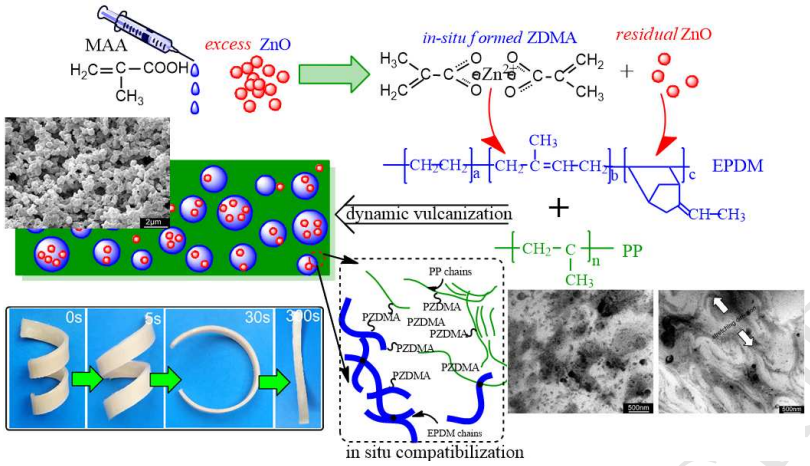
Graphical Abstract



Design of shape-memory materials based on sea-island structured EPDM/PP TPVs via in-situ compatibilization of methacrylic acid and excess zinc oxide nanoparticles

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Abstract

It is a challenge to achieve considerable shape-memory (SM) effect for typical sea-island structured polymer blends. In this paper, we successfully realized the SM behavior for classical ethylene-propylene-diene rubber/polypropylene (EPDM/PP) thermoplastic vulcanizates (TPVs) through a strong rubber/plastic interface compatibilized by in-situ formed zinc dimethacrylate (ZDMA) which came from methacrylic acid (MAA) and excess zinc oxide (ZnO) nanoparticles. With MAA/ZnO, the average size of EPDM particles reduced to 400~500 nm, which significantly enlarged EPDM/PP interfacial contact surfaces. The enhanced interface improved the efficiency of stress delivery between PP and EPDM phases, which was critical to fulfill the SM behavior. At the same time, residual ZnO nanoparticles stressed a reinforcement on EPDM phase and PP phase, which further improved the shape recovery (SR) and shape fixing (SF) of TPVs. Enhanced tensile strength (~9.1 MPa) and Young' modulus (~380 MPa), improved SF (~99%) and SR (~98%) of TPVs were achieved by tailoring the content of residual ZnO nanoparticles (MAA/ZnO=2:1.3) and the shape deformation temperature (120 °C).

Keyword: A. Polymer-matrix composites (PMCs); B. Interface; C. Deformation; shape memory