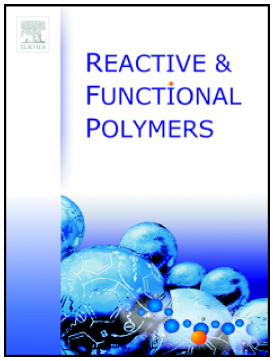

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PII: S1381-5148(17)30131-1
DOI: doi: 10.1016/j.reactfunctpolym.2017.07.002
Reference: REACT 3876

To appear in: *Reactive and Functional Polymers*

Received date: 17 April 2017
Revised date: 13 July 2017
Accepted date: 20 July 2017

Please cite this article as: Xingjian Li, Yaru Wang, Ruiqing Wu, Yi Pan, Zhaohui Zheng, Xiaobin Ding , Slide-ring shape memory polymers with movable cross-links, *Reactive and Functional Polymers* (2017), doi: 10.1016/j.reactfunctpolym.2017.07.002

Slide-Ring Shape Memory Polymers with Movable Cross-links

Xingjian Li,[1,2] Yaru Wang,[1,2] Ruiqing Wu,[1,2] Yi Pan,[1] Zhaohui Zheng,[1] Xiaobin Ding[1]*

1. Chengdu Institute of Organic Chemistry, Chinese Academy of Sciences, Chengdu, 610041, China.

2. University of Chinese Academy of Sciences, Beijing, 100081, China

*Corresponding author.

E-mail address: xbding@cioc.ac.cn (X. Ding)

ABSTRACT: The development of shape memory materials to achieve recoverable high-strain capacities at high concentration of the crosslinker is still a great challenge due to their mutual exclusiveness. Here, slide-ring shape memory polymers (SMPs) with movable cross-links were prepared by varying the amount of the polyrotaxane cross-linkers. The slide-ring SMPs not only exhibit a combination of high strength and toughness, but also outstanding recoverable high-strain capacities and fast shape recovery. The elongation of the slide-ring SMPs at 1 mol% crosslinker was as high as 881%, closer to physically cross-linked SMPs. As the growing deformation strain from 100% to 800%, the slide-ring SMPs still showed excellent shape memory performance with more than 90% shape fixity and shape recovery. The comparative analysis among movable cross-linking, chemical cross-linking and physical cross-linking SMPs in a different way revealed that the sliding effect of the polyrotaxane cross-linking is responsible for outstanding recoverable high-strain capacities of slide-ring SMPs. This design may provide a promising strategy for brittle shape memory materials to obtain high-strain capacities, such as epoxy resin and polylactic acid.

Keywords: polyrotaxane; shape memory polymers; movable cross-linker; high strength and toughness; slide-ring materials

1. Introduction

Shape memory polymers (SMPs) are able to be programmed to one or more temporary shapes that can be triggered to return to their original shape, usually through the application of heating [1,2]. The shape transition caused by a change in temperature is called a thermally induced shape-memory effect (TSME) [1]. The molecular origin of TSME is based on the basic