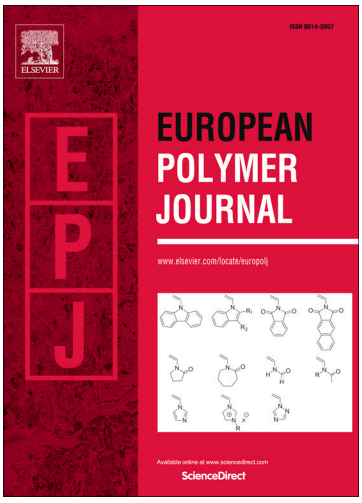

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Correlation between structure and responsivity in PNIPAM based nanocomposites: a combined nano- and macroscale view

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Abstract

Thermosensitive hydrogels have enormous potential, e.g. in sensors, actuators, microfluidics or drug delivery systems. In these applications the tuneability of their response rate is a key parameter and is therefore of great interest. However, the applicability of these systems is subject to limitations, which may be overcome by enhanced nanocomposite materials. This paper presents a systematic study of the thermal response of graphene oxide (GO) – and carbon nanotube (CNT) – poly-(N-isopropylacrylamide) composite systems, and investigates the effect of the nanoparticle filler content, both on the nanoscale and the macroscopic level. While the equilibrium swelling properties of the different nanocomposites are only slightly influenced, the kinetics of the response of the swelling medium following an abrupt temperature increase from 20 to 40 or 50 °C can vary within wide limits depending on the type or the amount of nanoparticle loading, as well as on the temperature difference.

Keywords: responsive hydrogel, deswelling kinetics, nanocomposite, SANS

1. Introduction

Hydrogels with environmental sensitivity [1–4] can react to changes in their surroundings, which makes them ideal candidates for actuators [5–8], sensors [9,10], microfluidics [11,12] and drug delivery systems [13–17]. Their response can be triggered by several means, e.g., change of the swelling medium [18,19], temperature [20], electromagnetic field [21], etc. Moreover, in many cases the response depends on the nature of the surrounding media (composition, pH [22–25]) and can be altered by factors such as copolymerisation [26,27]. Poly(N-isopropylacrylamide) gel (PNIPAM) is one of the best known temperature sensitive