

Self-assembling temperature-responsive composite sheets prepared from laponite and a cationic poly(*N*-isopropylacrylamide) graft copolymer

Ruixue Liu^a, Nicola Tirelli^b and Brian R. Saunders^a

^a *Polymer Science and Technology Group, School of Materials, University of Manchester, Grosvenor Street, M1 7HS, UK.*

^b *School of Pharmacy and Pharmaceutical Sciences, University of Manchester, Coupland Street, Oxford Road, M13 9PL, UK.*

Abstract

Temperature-responsive polymers continue to attract considerable attention in the literature both from the fundamental and potential application viewpoints. Earlier work showed that cationic poly(*N*-isopropylacrylamide) (PNIPAm) chains strongly adsorbed to laponite particles [1]. In this study we examine for the first time the morphology and properties of self-assembled temperature-responsive sheets that spontaneously form within aqueous dispersions of laponite particles containing a cationic PNIPAm *graft* copolymer. The copolymer, PDMA⁺_x-*g*-(PNIPAm_n)_y, was prepared using ATRP and consisted of a backbone of quaternarized N,N-dimethylaminoethyl methacrylate units (DMA⁺) with PNIPAm side arms. The macroscopic sheets were examined using SEM and variable-temperature phase contrast microscopy. Sheet contraction began at ca. 27 °C, which is well below the cloud point for the solution polymer (34 °C). The sheet contraction was most pronounced at ca. 34 °C, which corresponded to a crumpling transition, and exhibited significant reversibility. The dispersions formed reversible gels when the temperature exceeded 34 °C. Variable-temperature dynamic rheological measurements showed that at 50 °C the sheets provided the main elastic contribution to the gels mechanical properties. The sheets were able to be purified by centrifugation and redispersion in water. The dispersions of purified sheets also exhibited temperature-triggered gelation. The laponite / copolymer sheets discussed here are an entirely new type of temperature-triggered gel forming system and have excellent potential for architectural control and manipulation. One potential application for these self-assembled systems is as actuators.

References

- (1) J. M. Saunders.; B. R. Saunders. *Chem. Commun.*, 28, 3538–3540, **2005**.
- (2) R. Liu, P. De Leonardis, F. Cellési, N. Tirelli and B. R., Saunders., *Langmuir*, *In Press*, **2008**.