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# Thermal and Photoresponsive Properties of Composite Gels Consisting of Polymer-Brush-Afforded Silica Particles and Azobenzene-Containing Liquid Crystals

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A liquid-crystalline physical gel formed by the fibrous aggregation of gelators in liquid crystals (LCs) have been recognized as a new class of soft materials and extensively investigated.<sup>1</sup> A particle/LC composite gel is a kind of liquid-crystalline physical gels in which particles act as the gelator. Recently, we have reported the viscoelastic properties and photoinduced gel–sol transition of particle/LC composite gels containing an azobenzene compound. Then, we have found that the photoinduced gel–sol transition is useful for the photochemical healing of surface cracks on the composite gels.<sup>2,3</sup> However, the mechanical properties of the particle/LC composite gels are not enough for practical uses. In this study, we have therefore attempted to improve the mechanical properties of the composite gels by introducing polymer components into particle/LC composites. For this purpose, we have employed polymer-brush-afforded silica particles (P-SiPs) whose surface is chemically modified with polymer chains.<sup>4</sup>
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A P-SiP/LC composite became a self-standing gel and showed the storage elastic modulus over 10<sup>4</sup> Pa at room temperature, which was approximately ten times larger than that of the particle/LC composite gels without grafted polymer chains on particles. Interestingly, the P-SiP/LC composite gels exhibited a transition between hard gel and soft gel, in addition to a usual gel–sol transition. Optical microscope observations and thermal analyses revealed that the former transition was derived from the glass–rubber transition of the grafted polymer chains whereas the latter was caused by the deformation of the inner network structure consisting of P-SiPs. Furthermore, we have also investigated the photoresponsive properties of the P-SiP/LC composite gels doped with an azobenzene compound.
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