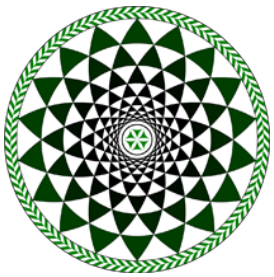

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Self-Healing Abilities of Composites Consisting of Polymer-Brush-Afforded Silica Particles and Photoresponsive Liquid Crystals

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Self-healing materials are expected to extend the lifetimes of a variety of products. Recently, we have developed a self-healing material using a particle/liquid-crystal (LC) composite gel containing an azobenzene compound. The particle/azo-doped LC composite gel showed the gel–sol transition by the trans–cis photoisomerization of an azo dopant. The photoinduced gel–sol transition could be successfully applied to the light-assisted mending of surface cracks on the composite gel.¹ However, owing to their poor elastic nature, surface dents made on the composite gels could not be repaired. In this study, we employed polymer-brush-afforded silica particles (P-SiPs) as particle components of the composite gels to improve their elasticity. Then, we investigated mechanical and self-healing properties of P-SiP/LC composite gels.²

A P-SiP is a core-shell particle in which a core is a spherical silica particle (diameter = 130 nm) and a shell consists of poly(methyl methacrylate) chains densely grafted on the core.³ A composite using P-SiPs and a nematic LC (4-pentyl-4'-cyanobiphenyl) became a self-supporting gel at room temperature. A physical network structure formed by P-SiPs in LC matrix will be responsible for the solid-like nature of the composite. The surface dents produced on the composite have been spontaneously repaired after removing the mechanical stress because of the rubbery nature of grafted polymer chains of P-SiPs. In addition, a P-SiP/LC composite containing a small amount of an azobenzene compound (4-butyl-4'-methoxyazobenzene) exhibited a gel–sol transition by trans–cis photoisomerization of the azo dopant. Therefore, the light-assisted mending of the surface cracks has been achieved using the photoinduced gel–sol transition. We have successfully developed a material which can repair two types of damages (a surface dent and a surface crack).

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