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Electronic Supplementary Information

Preparation of temperature-induced shapeable film material from guar gum-based gel with an ionic liquid

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Preparation of gel of guar gum (GG) with BMIMCl

As a typical procedure for the preparation of the gel, guar gum (Wako, 0.15 g) was dissolved in BMIMCl (Fluka, 1.0 g) by heating at 100°C for 5 h. After the solution was cooled to room temperature, acetone was added and the system was kept standing at room temperature for 12 h. The resulting material was taken out and washed with ethanol to give the gel.

Preparation of film of GG with BMIMCl

The resulting gel obtained by the above experiment was divided into two equal parts to make an appropriate size for formation of a film. A piece of the gel was soaked in ethanol at room temperature for 12 h. The obtained hard material was taken out and dried at room temperature. Then, the hard material was put on a compression machine and compressed applying gradually variable forces maximum up to about 10 MPa. The obtained film was soaked in ethanol for 2 h to remove excluded BMIMCl. Further drying at room temperature yielded the dry thin film with thickness of ca. 0.5 mm.

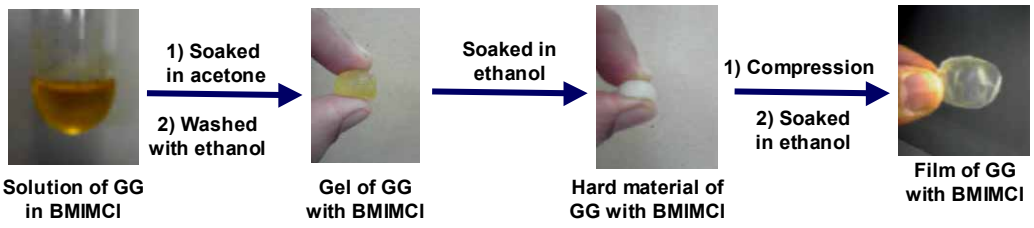

Fig. S1. Photographs of materials obtained at each step.

Demonstration of tempearture-induced shaping ability of the film

A piece of the film (ca. 3 cm x 1.2 cm) was twisted to a desired shape and was heated up to a temperature of ca. 70 - 80 ^{o}C. The film became hard and retained the shape for few minutes after heating was removed. Then, the film was kept standing at room temperature to become soft and return back to the original shape after ca. 15 minutes.

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Measurements

XRD measurements were conducted using a PANalytical X' Pert Pro diffractometer with Ni-filtered CuKα radiation (λ = 0.15418 nm). Elemental analyses were performed using a Perkin Elmer 2004 CHNS/O analyzer. The tensile strength was measured on a tensile tester (Little Senstar LSC-1/30, Tokyo Testing Machine Co.). Electrical conductivities were measured by applying direct current through the samples using Sanwa (AU-31) multi tester (Sanwa Electric Instrument Co. Ltd, Tokyo) following the method as described with modification.[1] The following equation was used to calculate the electrical conductivity; R = Specific resistance × L / A, where L = distance between the two probes (in our experiments; L = 0.3 cm) and A = cross sectional area of the sample (for our samples; A = 0.012 (± 0.002) cm^2. Specific resistance = (R × A) / L was calculated using the R value (Ohm) obtained using the resistance mode of the multi tester. Specific resistance was calculated with the unit of Ohm·cm. The reciprocal value of the specific resistance was calculated as electrical conductivity in $S \cdot cm^{-1}$.

1. W. Guoquan and Z. Peng, *Polym. Eng. Sci*., 1997, **37,** 96.

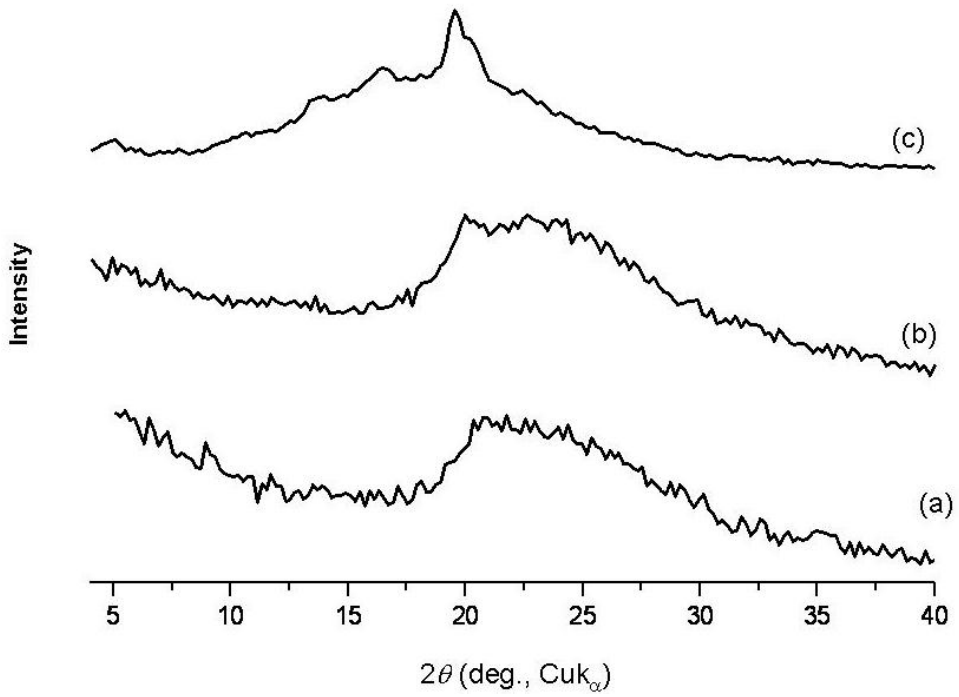

Fig. S2 XRD patterns of gel of GG with BMIMCl (a), hard material of GG with BMIMCl (b), and guar gum powder (c).

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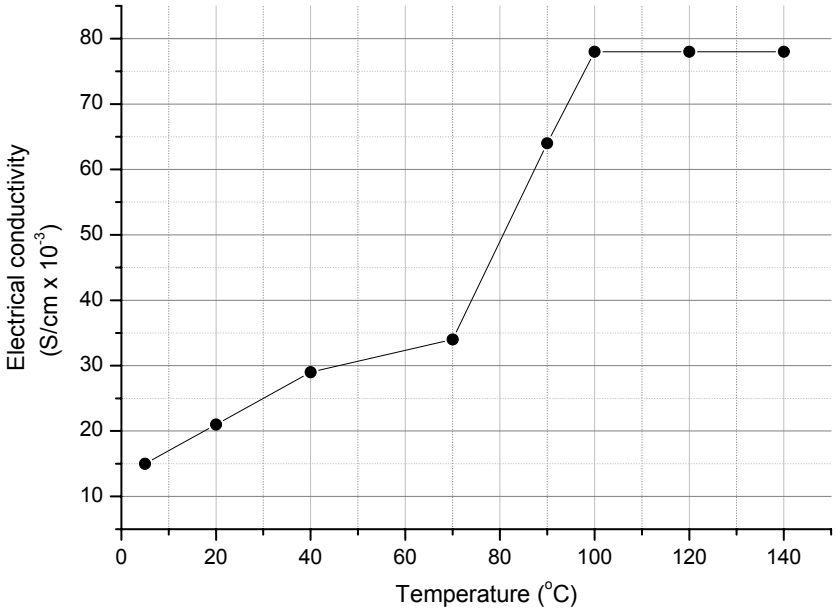

Fig. S3. Electrical conductivity of a guar gum film with BMIMCl vs. temperature.