Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Improvement of lipidic bicontinuous cubic phases by the addition of a zwitterion with strong hydration ability and kosmotropicity

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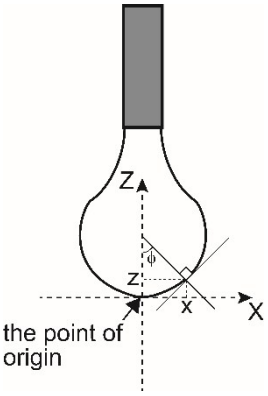
Young-Laplace method[S1,S2]

Outline shapes of liquid surface are expressed by using the Young-Laplace equation. In the case of the pendant drop method, it is supposed that Young-Laplace equation are written by those simultaneous differential equation.

$$\frac{dx}{ds} = cos\Phi$$

$$\frac{dz}{ds} = sin\Phi$$

$$\frac{d\Phi}{ds} = 2 + \beta z - \frac{sin\Phi}{x}$$



In this regard, β is the shape factor that is defined by the formula below.

$$\beta \equiv - \frac{\Delta\rho g b^2}{\gamma}$$

b: a radius of principal curvature at the low point of a pendant drop (the point of origin)

s: a length of an arc from at the point of origin

x: x-coordinate of an outline curve

z: z-coordinate of an outline curve

Φ: an angle between a normal line of an outline curve and a vertical line

γ: a surface tension of liquid

$\Delta\rho$: a density difference between a pendant drop phase and an environment phase

g: acceleration of gravity

When it is appropriate that the outline shape of a pendant drop obeys the Young-Laplace equation, β and b are calculated by analyzing the observed outline shape, and then γ (surface tension) can be calculated in combination with $\Delta\rho$. Precise surface tension can be obtained by fitting numerous coordinates (several hundred points) of the outline curve and the Young-Laplace theoretical curve.

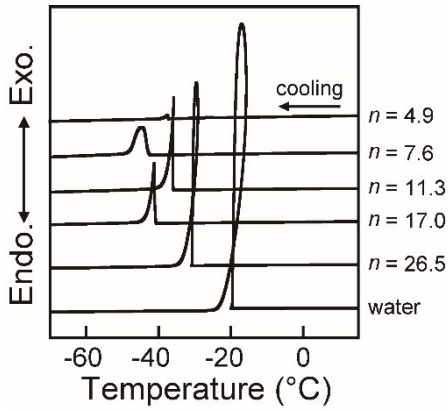


Fig. S1 DSC thermograms of **ImZI**-$n$$H_2O$ on 1st cooling.

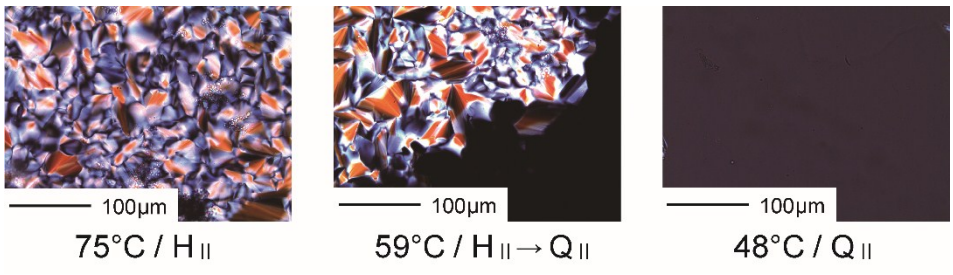


Fig. S2 POM images of the **MO**/water/**ImZI** mixtures in the ratio of 70/27/3 by weight at various temperatures.

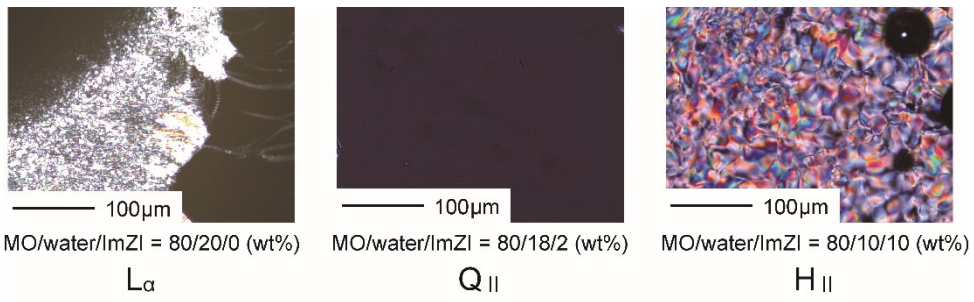


Fig. S3 POM images of the **MO**/water/**ImZI** mixtures at 30 °C in the various component ratios.

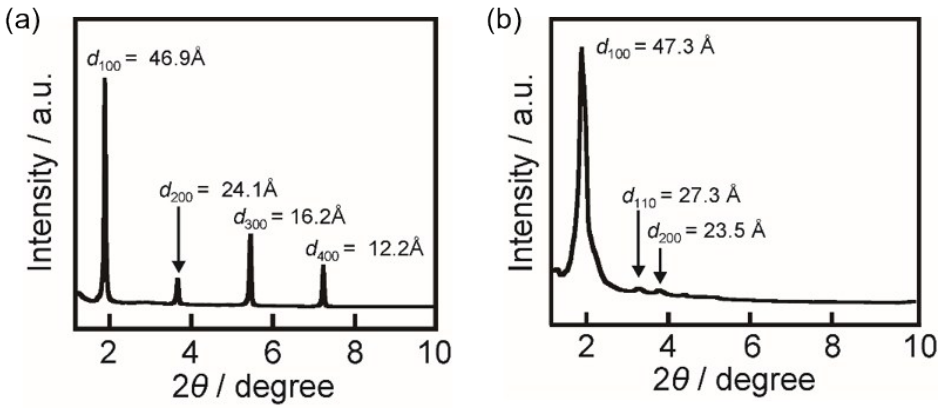


Fig. S4 (a) X-ray diffraction pattern of the **MO**/water mixture in the ratio of 70/30 by weight at 30 °C after 2 days at ambient condition. It shows a L_α phase. (b) X-ray diffraction pattern of the **MO**/water/**ImZI** mixture in the ratio of 60/24/16 by weight at 30 °C. It shows a H_{II} phase.

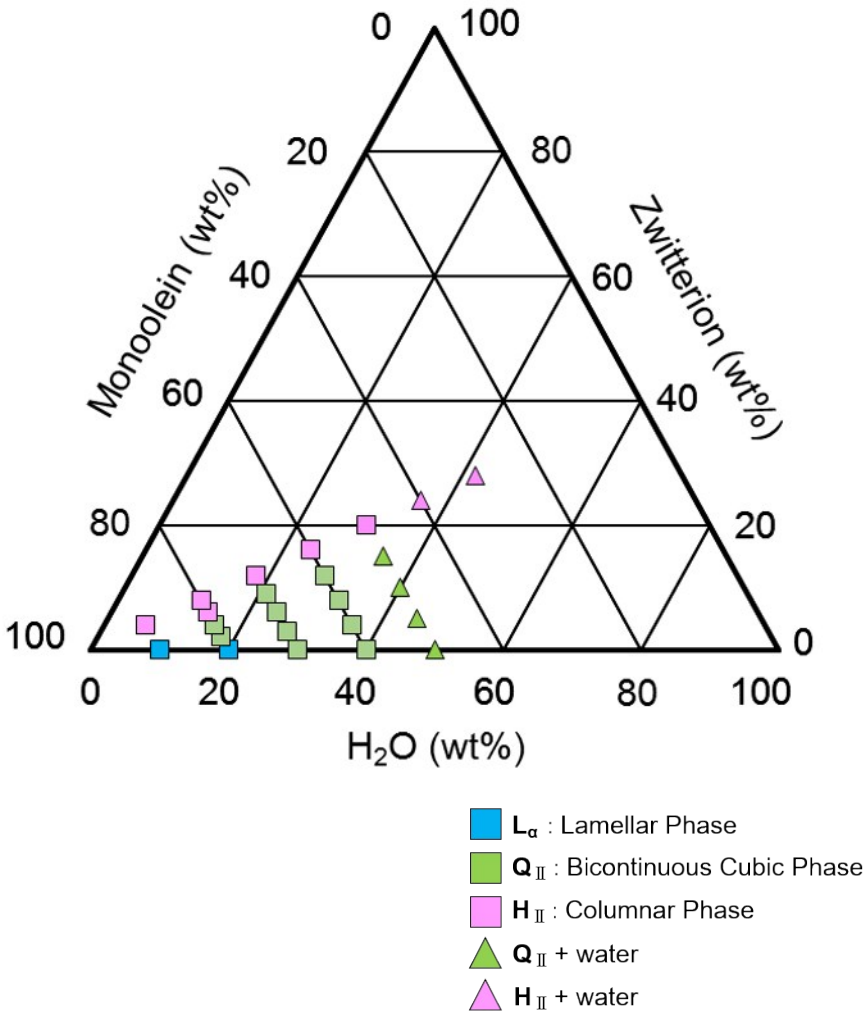


Fig. S5 Triangular diagram of the **MO**/water/**ImZI** mixtures.

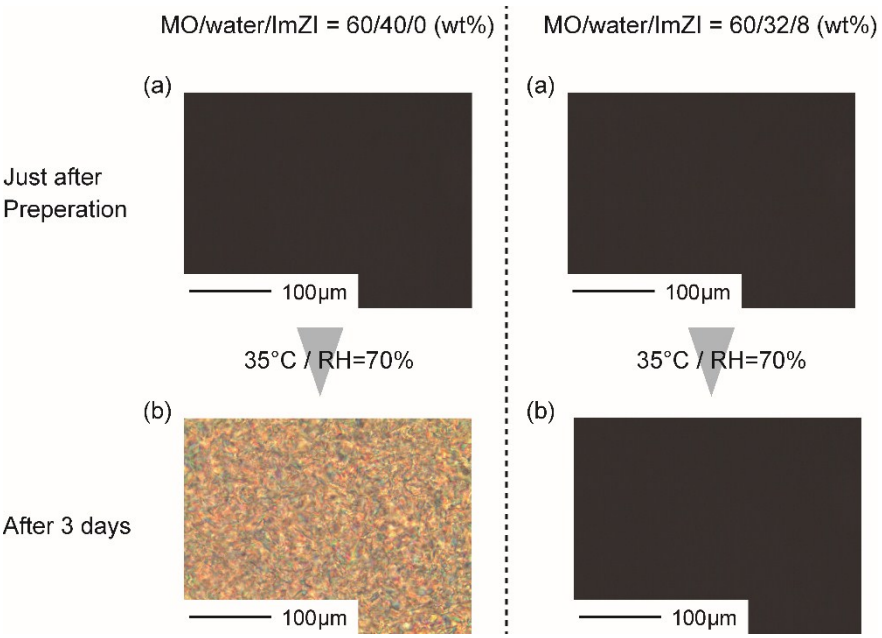


Fig. S6 POM images of the **MO**/water/**ImZI** mixtures in the ratio of 60/40/0 and 60/32/8 by weight. (a) just after preparation and (b) after 3 days.

References

[S1] Y. Rotenberg, L. Boruvka and A. W. Neumann, *J. Colloid Interface Sci.*, 1983, **93**, 169-183.

[S2] Y. Kazemzadeh, S. Sourani, M. Reyhani, A. Shabani and E. Maghami, *Open Access Library Journal*, 2014, **1**, 1-7.