

## **Electronic Supplementary Information**

### **Lipid-membrane-incorporated hydrophobic photochromic molecules prepared by the exchange method using cyclodextrins**

Atsushi Ikeda,\* Shodai Hino, Kengo Ashizawa, Kouta Sugikawa, Jun-  
ichi Kikuchi, Manami Tsukamoto and Kazuma Yasuhara

**Table S1** Average hydrodynamic diameters,  $D_{hy}$  (nm), of LMI1 and LMI2 prepared by the exchange method, determined using dynamic light scattering at 25 °C.

[Guest]/[DMPC] (mol%)	<b>1</b>		<b>2</b>	
	Average $D_{hy}$ /nm	PDI <sup>a</sup>	Average $D_{hy}$ /nm	PDI <sup>a</sup>
0.0	80.3	0.15	84.6	0.16
2.5	75.2	0.14	89.5	0.16
5.0	76.3	0.15	84.8	0.19
10.0	82.9	0.17	84.6	0.22
20.0	82.3	0.17	84.6	0.20

<sup>a</sup>PDI: Polydispersity index.

**Table S2** Average hydrodynamic diameters,  $D_{hy}$  (nm), of LMI1 and LMI2 prepared by the premixing method, determined using dynamic light scattering at 25 °C.

[Guest]/[DMPC] (mol%)	<b>1</b>		<b>2</b>	
	Average $D_{hy}$ /nm	PDI <sup>a</sup>	Average $D_{hy}$ /nm	PDI <sup>a</sup>
0.0	81.6	0.13	81.6	0.13
2.5	76.4	0.12	83.3	0.14
5.0	77.0	0.13	77.3	0.13
10.0	73.0	0.11	82.4	0.11
20.0	80.7	0.11	73.0	0.12

<sup>a</sup>PDI: Polydispersity index.

**Table S3** Average hydrodynamic diameters,  $D_{hy}$  (nm), of LMI1 and LMI2 prepared by the exchange method before and after photoirradiation, determined using dynamic light scattering at 25 °C.

Conformation	<b>1<sup>a</sup></b>		<b>2<sup>a</sup></b>	
	Average $D_{hy}$ /nm	PDI <sup>b</sup>	Average $D_{hy}$ /nm	PDI <sup>b</sup>
<i>trans</i> <sup>c</sup>	76.7	0.13	82.1	0.19
<i>cis</i> <sup>d</sup>	72.1	0.13	78.4	0.17
<i>trans</i> <sup>e</sup>	70.2	0.15	84.3	0.21

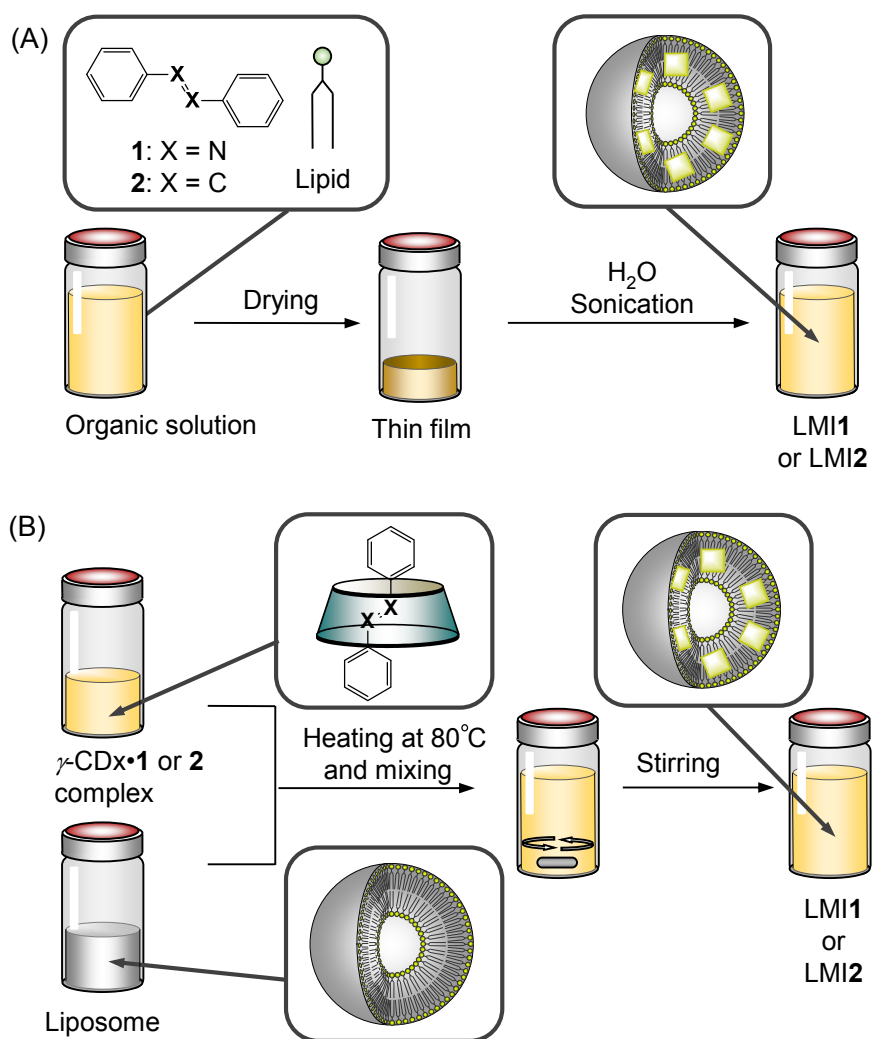
<sup>a</sup>[guest]/[DMPC] = 10 mol%.

<sup>b</sup>PDI: Polydispersity index.

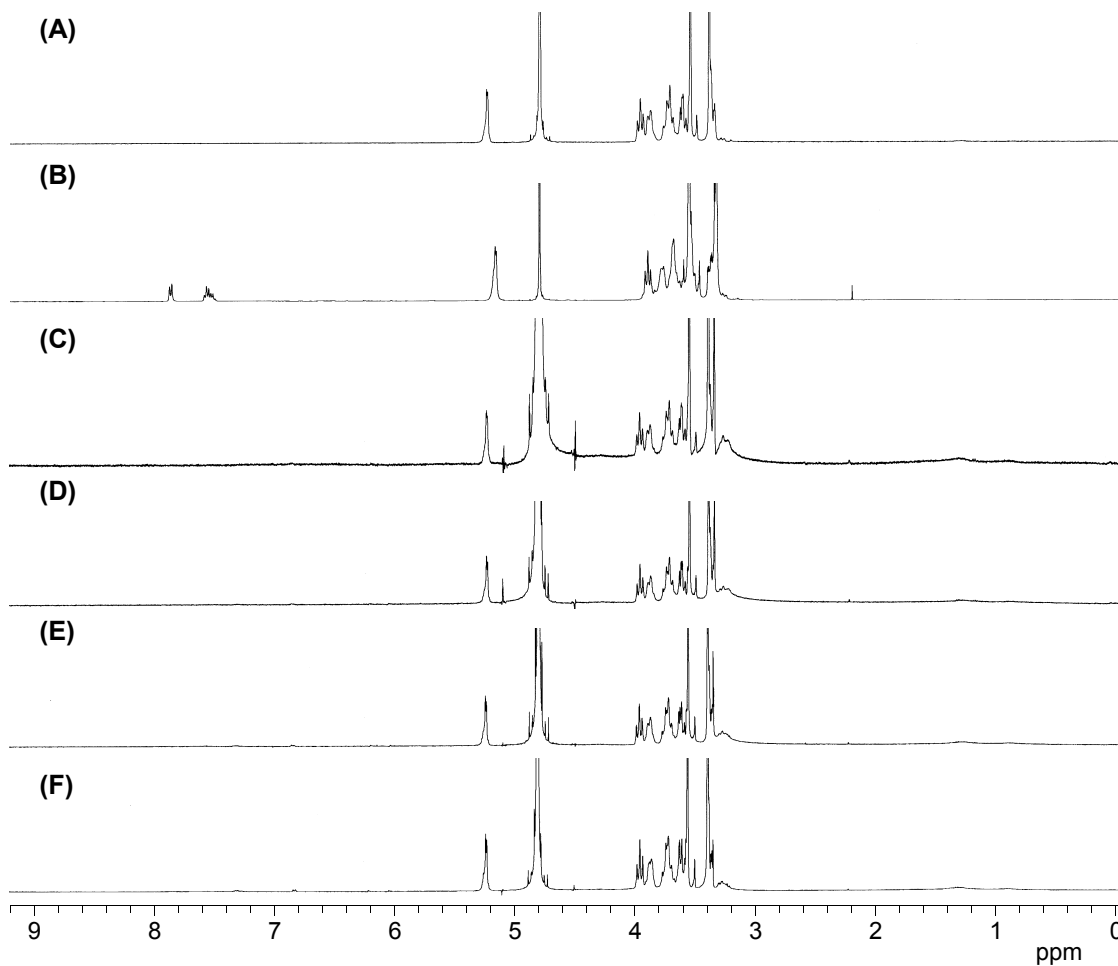
<sup>c</sup>[*trans*-1]:[*cis*-1] = 87:13 (mol/mol), [*trans*-2]:[*cis*-2]:[phenanthrene] = 100:0:0 (mol/mol/mol).

<sup>d</sup>[*trans*-1]:[*cis*-1] = 22:78 (mol/mol), [*trans*-2]:[*cis*-2]:[phenanthrene] = 4:92:4 (mol/mol/mol).

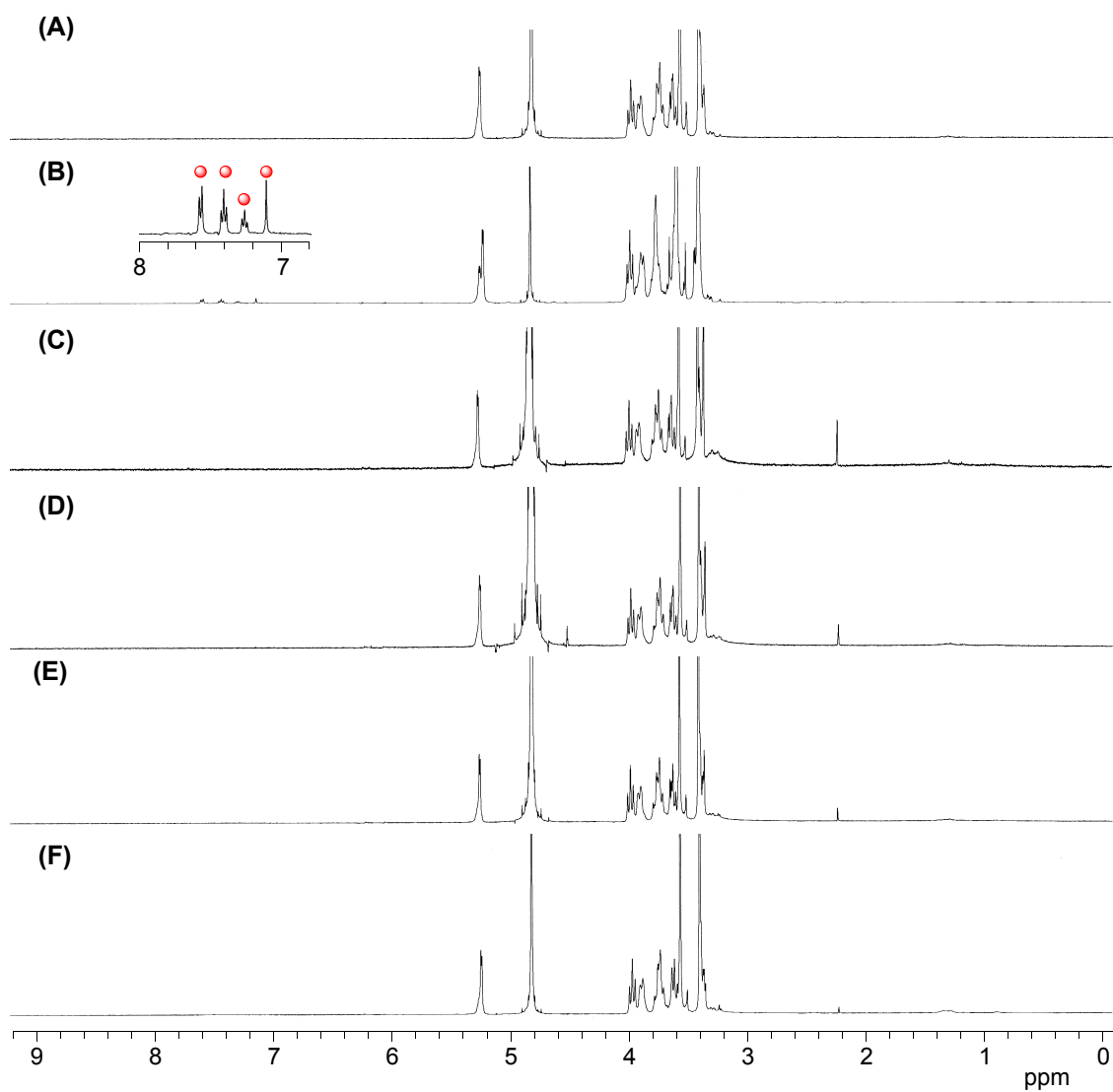
<sup>e</sup>[*trans*-1]:[*cis*-1] = 76:24 (mol/mol), [*trans*-2]:[*cis*-2]:[phenanthrene] = < 1:< 1:> 99 (mol/mol/mol).



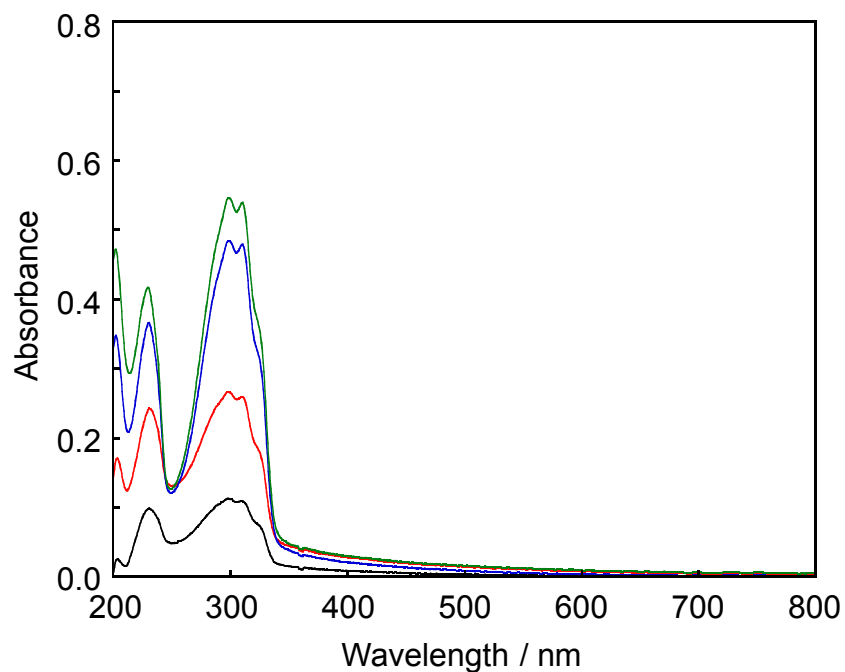
**Fig. S1** (A) The premixing method, (B) the exchange method for the preparation of LMI1 and LMI2.



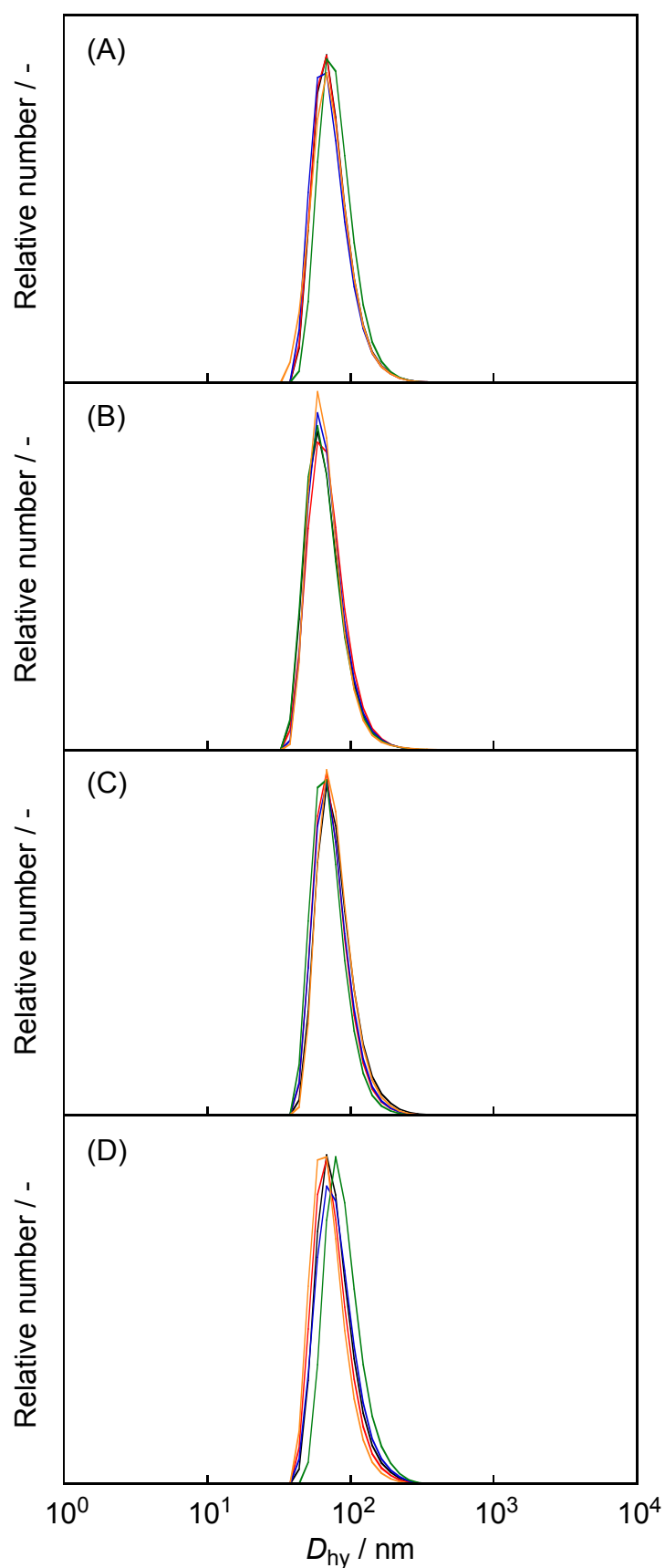
**Fig. S2**  $^1\text{H}$  NMR spectra at 400 MHz in  $\text{D}_2\text{O}$  at 25  $^\circ\text{C}$  of (A)  $\text{DMe-}\beta\text{-CDx}$ , (B) the  $1\cdot\text{DMe-}\beta\text{-CDx}$  complex, LMI1:  $[1]/[\text{DMPC}]$  = (C) 2.5 mol%, (D) 5.0 mol%, (E) 10 mol% and (F) 20 mol%.



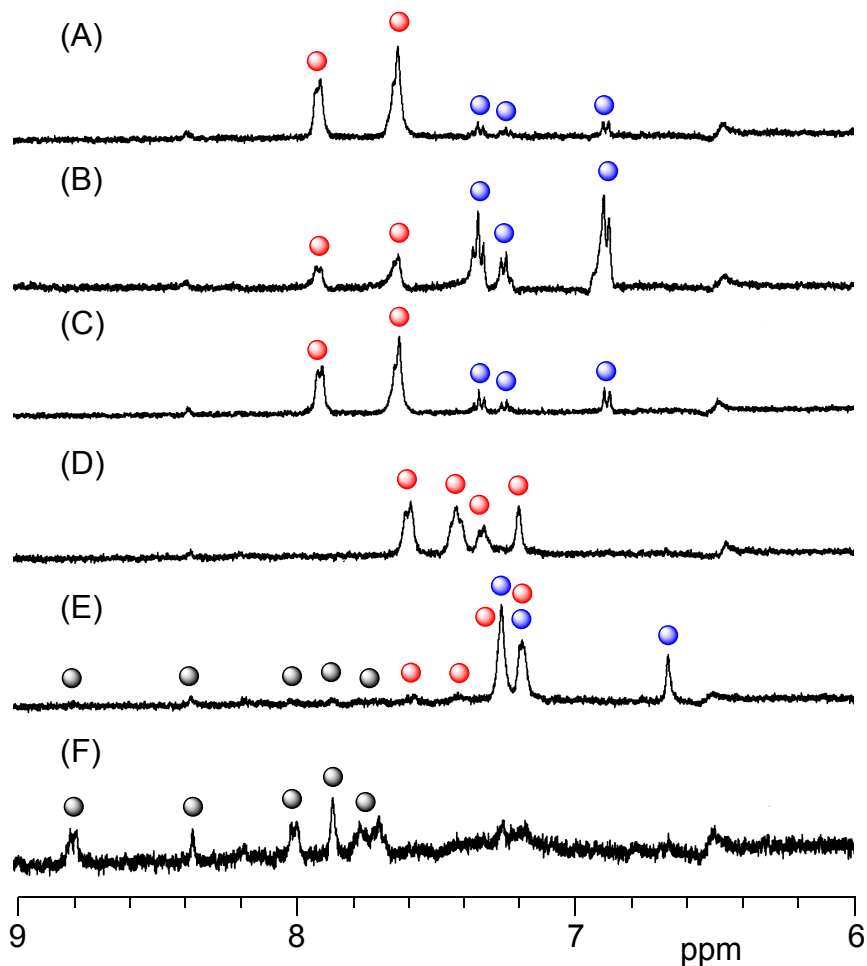
**Fig. S3** <sup>1</sup>H NMR spectra at 400 MHz in D<sub>2</sub>O at 25 °C of (A) DMe-β-CDx, (B) the 2•DMe-β-CDx complex, LMI2: [2]/[DMPC] = (C) 2.5 mol%, (D) 5.0 mol%, (E) 10 mol% and (F) 20 mol% (●: 2 in the DMPC•DMe-β-CDx complex). The insets show the region of 6.8–8.0 ppm.



**Fig. S4** UV-vis absorption spectra of LMI2 prepared by the premixing method. [1 or 2]/[DMPC] = (a) 2.5 (black line), (b) 5.0 (red line), (c) 10.0 (blue line) and (d) 20.0 (green line) mol%. All absorption spectra were obtained by subtracting the light scattering of DMPC liposomes and were measured at 25 °C (1 mm cell).

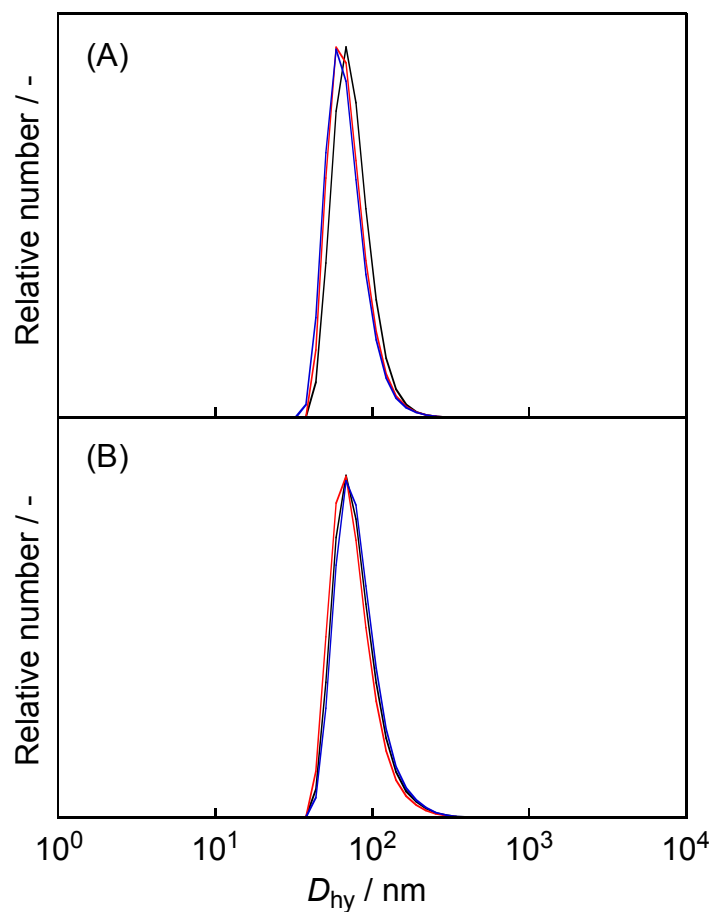


**Fig. S5** Hydrodynamic diameters ( $D_{hy}$ ) of (A) LMI1 and (B) LMI2 prepared by the exchange method and (C) LMI1 and (D) LMI2 prepared by the premixing method, using DLS measurements. [1 or 2]/[DMPC] = (a) 0.0 (black line), (b) 2.5 (red line), (c) 5.0 (blue line), (d) 10.0 (green line) and (e) 20.0 (orange line) mol%, room temperature.



**Fig. S6**  $^1\text{H}$  NMR spectra of extracts from LMI1 (A) before and (B) after UV light irradiation ( $330 < \lambda < 380$  nm; *trans-to-cis*) and (C) visible light irradiation ( $\lambda > 400$  nm; *cis-to-trans*) and from LMI2 (D) before and (E) after visible (UVA) light irradiation ( $\lambda = 365$  nm; *trans-to-cis*) and (F) UV (UVC) light irradiation ( $\lambda = 254$  nm; *cis-to-trans*).  $\text{CDCl}_3$ , [1 or 2]/[DMPC] = 10 mol% [●: 1(*trans*) or 2(*trans*), ●: 1(*cis*) or 2(*cis*), ●: phenanthrene].





**Fig. S7** Hydrodynamic diameters ( $D_{hy}$ ) of (A) LMI1 and (B) LMI2 before and after photoirradiation from DLS measurements. LMI1 (*trans*) and LMI2 (*trans*) before photoirradiation: black line, LMI1 (*cis*) and LMI2 (*cis*) after photoirradiation: red line, LMI1 (*trans*) and LMI2 (*trans*) after photoirradiation: blue line, [1 or 2]/[DMPC] = 10.0 mol%, room temperature.