## **Supporting Information**

Correlation between the Structure of Water in the Vicinity of Carboxybetaine Polymers and Their Blood-compatibility

Hiromi Kitano,<sup>1</sup>\* Susumu Tada,<sup>1</sup> Takayuki Mori,<sup>1</sup> Kohei Takaha,<sup>1</sup> Makoto Gemmei-Ide,<sup>1</sup> Masaru Tanaka,<sup>2</sup> Mitsuhiro Fukuda,<sup>3</sup> Yoshiyuki Yokoyama.<sup>4</sup>

<sup>1</sup>Department of Chemical and Biochemical Engineering, Toyama University, Toyama 930-8555, Japan. <sup>2</sup>Creative Research Initiative "Sousei" (CRIS), Hokkaido University, Sapporo 060-0812, Japan. <sup>3</sup>Textile Materials Science Laboratory, Hyogo University of Teacher Education, Yashiro-cho, Hyogo 673-1494, Japan. <sup>4</sup>Central Research Institute, Toyama Industrial Technology Center, Takaoka 933-0981, Japan.

**Raman Spectroscopic Measurement** The Raman spectra of various aqueous polymer solutions were recorded on a NR-1100 spectrophotometer (Japan Spectroscopic, Co., Tokyo, Japan; light source, Argon laser 488.0 nm) with a band resolution of 5 cm<sup>-1</sup>. For the polarization geometries X(ZZ)Y (parallel position,  $I_{//}$ ) and X(ZX)Y (perpendicular position,  $I_{\perp}$ ), a polarizer plate was rotated by exactly 90° in front of the slit, where X and Y are the directions of laser beam and observation, respectively. The electric vector of the laser beam was maintained in the vertical Z direction for both geometries. A polarization scrambler was used between the slit and the polarizer.

**ATR-FTIR Measurement** A ZnSe element (80x10x5 mm, Trough Plate ZnSe  $45^{\circ}$ ; Pike Technologies, Madison, WI) was used for the measurement of ATR-IR. An ATR cell was tightly sealed except portals for the inlet and outlet of the dry-N<sub>2</sub> and humid air of a constant relative humidity (RH), and set in an observation chamber of Spectrum One NTS FT-NIR spectrophotometer, Perkin-Elmer. The RH value was monitored at 25 °C with a Model SU-610 Humidity Meter, Testoterm Inc., Yokohama, Japan. Polymer films with a thickness of 10 µm were prepared by the cast method on the ZnSe element from chloroform solution (50 mg.mL<sup>-1</sup>) under dry-N<sub>2</sub>, and dried at 25 °C under vacuum for 3 h. The thickness of the film was determined from the diffraction of visible light measured by a fiber optic multi-channel photo-detection system (MCPD-1100, Otsuka Electronics, Hirakata, Japan) coupled with an optical microscope (Optiphot, Nikon, Tokyo, Japan).

Platelet Adhesion Test. A cover glass (thickness 0.15 mm; Matsunami, Osaka, Japan) was

immersed in conc. sulfuric acid for several hours, rinsed with water. The hydrophilic glass was immersed into 0.05 (v/v) % octadecyltrichlorosilane solution (solvent, chloroform) for 2 hours, rinsed with chloroform and methanol, and dried by flashing  $N_2$  gas. The polymer solution (0.3 mL, 5 mg/mL) chloroform (in the case of Poly(CMB-*r*-BMA) (CMB, 31 and 34 mol%), chloroform : methanol = 15:1)) was dropped on the hydrophobic glass surface in a desiccator, and the glass was dried in vacuo for 6 h to give a cast film on its surface. For the preparation of spin-coated thin films, the polymer solution was slowly dropped on the hydrophobic cover glass, while the glass was rotated at 1000 rpm using a spin-coater (Model ASS-301, Able, Tokyo, Japan). Similarly, other spin-coated thin films were prepared with the methanolic polymer solution (0.3 mL, 5 mg/mL methanol (in the case of Poly(CMB-r-BMA) (CMB, 23, 27, 31 and 34 mol%)) on the hydrophilic cover glass. Human blood was drawn from healthy volunteers and mixed with a 1/9 volume of acid citrate dextrose (ACD). Platelet rich plasma (PRP) and platelet poor plasma (PPP) were obtained by centrifugation of the blood at 1200 rpm for 5 min and at 3000 rpm for 10 min, respectively. The plasma containing  $1.0 \times 10^5$ cells/mL of platelet was prepared by mixing PRP with PPP. The platelet concentration was determined by an automated hematology analyzer (Sysmex SE-9000, Toa Medical Electronics, Tokyo, Japan). Then, 200  $\mu$ L of the plasma was placed on the coated film, and incubated for 60 min at 37 °C. After the film was washed three times with phosphate-buffered saline (PBS), it was immersed into 1 % glutaraldehyde of PBS for 60 min at 4 °C to fix the adhered platelet. The sample was freeze-dried, and sputter-coated using gold prior to observation under scanning electron microscopy (JSM-840, JEOL, Tokyo, Japan). The coated film was washed three times with PBS before the platelet adhesion test.

**Contact Angle Measurement.** Static contact angles,  $\theta$ , of air bubble on the surface of various polymer films were measured at room temperature by the air-in-water method (CA-D, Kyowa Interface Science, Tokyo, Japan). The polymer film (thickness, ca. 3 µm) was prepared by the conventional method: a polymer solution (5 mg/mL in chloroform (in the case of Poly(CMB-*r*-BMA) (CMB, 31 and 34 mol%), chloroform : methanol = 15 : 1) was cast on a slide glass in a desiccator and dried at room temperature overnight. Sixty seconds after immersing the polymer film into water, an air bubble (10 µL) was attached to the film surface with a microsyringe, and the  $\theta$  value was quickly measured. Using the same apparatus, static contact angles,  $\theta$ , of water droplet (10 µL) on the surface of various polymer cast films (30 s after the contact with the water droplet) were measured, too. The  $\theta$  values were determined ten times to give a reliable average value. **Table S-1** shows the contact angles for copolymer films with various CMB : BMA ratios. Except the homopolymer, PBMA, the sum of contact angles obtained by the sessile drop and air-in-water methods was larger than 180 °, indicating

the response of polymer films to the contacting medium.

<b>Composition Ratio</b>	Contact Angle, $\theta$ (degree)							
CMB : BMA	Sessile Drop	Air-in-Water	Sum					
0:100	89.4	96.8	186.2					
4:96	81.2	124.5	205.6					
7:93	84.3	142.1	226.4					
14:86	82.6	150.3	232.8					
17:83	82.1	148.5	230.1					
23:77	84.6	149.9	234.8					
27:73	85.2	150.4	235.6					
69:31	90.8	152.9	243.3					
66 : 34	90.3	151.6	241.9					

Table S-1.	Contact	Angles	for Poly	vmer Films	with	Various	CMB:	BMA	Ratios
I GOIC D II	Contract					, allows			

**Calculation of Vibrational Frequencies Using a Density-Functional Method.** As the model compounds, various combination numbers of water and betaine were used. Molecular geometries of the model compounds were optimized and followed by the frequency calculation using a hybrid density functional (HDF) method, Becke3LYP (B3LYP)<sup>S-1,S-2</sup> with a 6-31++G(d,p) basis set. Recently, the B3LYP exchange-correlation method has been widely used to obtain the frequency of a number of molecular systems.<sup>S-3</sup> All the calculations were carried out on a clustered machine composed of 16 Pentium 4 processors using a GAUSSIAN 03 Rev.C02 program package.<sup>S-4</sup>

The deviation from the experimental frequency was generally found even for a single water molecule, when we employed larger basis sets and more accurate correlation. Our object is, however, the assignment of the experimental O-H stretching bands with the help of the theoretical frequency of the model compounds. Therefore, theoretical frequencies from the B3LYP/6-31++G(d,p)SCRF calculations using the shift parameter to the experimental ones were used in the present study. The frequencies of single water in vapor were obtained by tightly optimizing the structure, and the shift parameter was determined as 0.9578.

(S-1) (a) Becke, A. D. J. Chem. Phys. **1993**, 98, 1372, 5648. (b) Becke, A. D. Phys. Rev. A **1988**, 38, 3098.

(S-2) Lee, C.; Yang, W.; Parr, R. G. Phys. Rev. B 1988, 37, 785.

(S-3) (a) Reimers, J. R.; Hall, L. E. J. Am. Chem. Soc., **1999**, *121*, 3730. (b) Yoshida, H.; Ehara, A.; Matsuura, H. Chem. Phys. Lett. **2000**, *325*, 477.

(S-4) GAUSSIAN 03 Rev.C02; Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M.

A.; Cheeseman, J. R.; Montgomery, Jr., J. A.; Vreven, T.; Kudin, K. N.; Burant, J. C.; Millam, J. M.;
Iyengar, S. S.; Tomasi, J.; Barone, V.; Mennucci, B.; Cossi, M.; Scalmani, G.; Rega, N.; Petersson, G
A.; Nakatsuji, H.; Hada, M.; Ehara, M.; Toyota, K.; Fukuda, R.; Hasegawa, J.; Ishida, M.; Nakajima,
T.; Honda, Y.; Kitao, O.; Nakai, H.; Klene, M.; Li, X.; Knox, J. E.; Hratchian, H. P.; Cross, J. B.;
Adamo, C.; Jaramillo, J.; Gomperts, R.; Stratmann, R. E.; Yazyev, O.; Austin, A. J.; Cammi, R.;
Pomelli, C.; Ochterski, J. W.; Ayala, P. Y.; Morokuma, K.; Voth, G. A.; Salvador, P.; Dannenberg, J. J.;
Zakrzewski, V. G.; Dapprich, S.; Daniels, A. D.; Strain, M. C.; Farkas, O.; Malick, D. K.; Rabuck, A.
D.; Raghavachari, K.; Foresman, J. B.; Ortiz, J. V.; Cui, Q.; Baboul, A. G.; Clifford, S.; Cioslowski, J.;
Stefanov, B. B.; Liu, G.; Liashenko, A.; Piskorz, P.; Komaromi, I.; Martin, R. L.; Fox, D. J.; Keith, T.;
Al-Laham, M. A.; Peng, C. Y.; Nanayakkara, A.; Challacombe, M.; Gill, P. M. W.; Johnson, B.; Chen,
W.; Wong, M. W.; Gonzalez, C.; and Pople, J. A., Gaussian, Inc., Wallingford CT, 2004.