Improving CO_2/N_2 separation performance by nonionic surfactant Tween containing polymeric gel membranes

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1. Gas sorption method

(1) In order to eliminate gases present in the system and the sample, the system was evacuated by opening Valves 2 and 3 and closing Valve 1 for 3 h.

(2) Close Valves 2 and 3. Slowly open Valve 1 to make the gas progressively enter into the reference chamber until a required CO_2 pressure (P_1) was achieved in the reference chamber, and then Valve 1 was closed.

(3) Slowly opening Valve 2 to allow CO_2 in the reference chamber to enter into the sample chamber to contact the sample. After a constant pressure (P_2) was achieved, an equilibrium sorption was achieved. The quantity (mol) of CO_2 absorbed in the membrane can be calculated from

$$q_0 = \left[(p_1 - p_2)V_R - p_2 (V_S - V_m) \right] / RT ,$$

where *Vm* is the volume of the membrane sample, and *R* and *T* are gas constant and temperature, respectively.

(4) The reference chamber pressure was increased to *P* by repeating Step (2). Then, another equilibrium sorption at pressure P_e was achieved by repeating step (3). The accessorial sorption uptake of CO_2 can be calculated from

$$\nabla q = \left[(p - p_e)V_R - (p - p_e)(V_S - V_m) \right] / RT \cdot$$

Therefore, the overall quantity of CO_2 absorbed in the membrane at the pressure of *Pe* can be calculated from

$$q = \left[(p - p_2 + p)V_R - p_e (V_R + V_S - V_m) \right] \frac{T_0}{TP_0 V_m}$$

This step was repeated to obtain the sorption uptakes of CO_2 at different pressures.

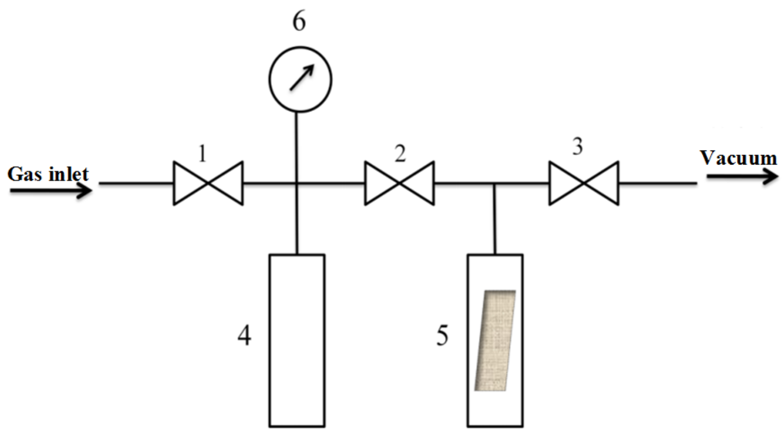

Fig. S1 Schematic diagram of gas sorption setup: 1, 2, 3-needle valve; 4-reference volume; 5-sample volume; 6-digital vacuum-pressure gauge

2. Photographs of PEBA2533/Tween-50 membranes

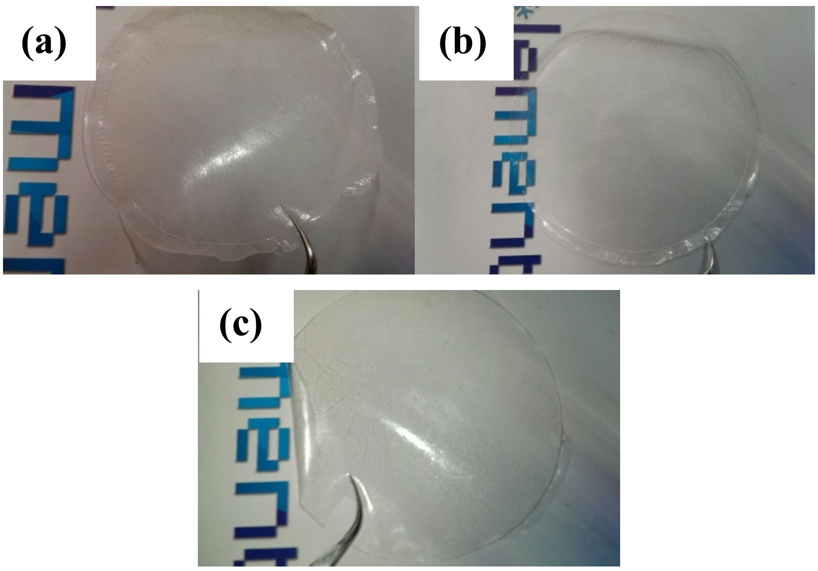

Fig. S2 Photographs of PEBA2533/Tween-50 membranes (a) PEBA2533/Tween20-50 membrane; (b) PEBA2533/Tween21-50 membrane; (c) PEBA2533/Tween80-50 membrane

3. Thermal analysis of gel membranes

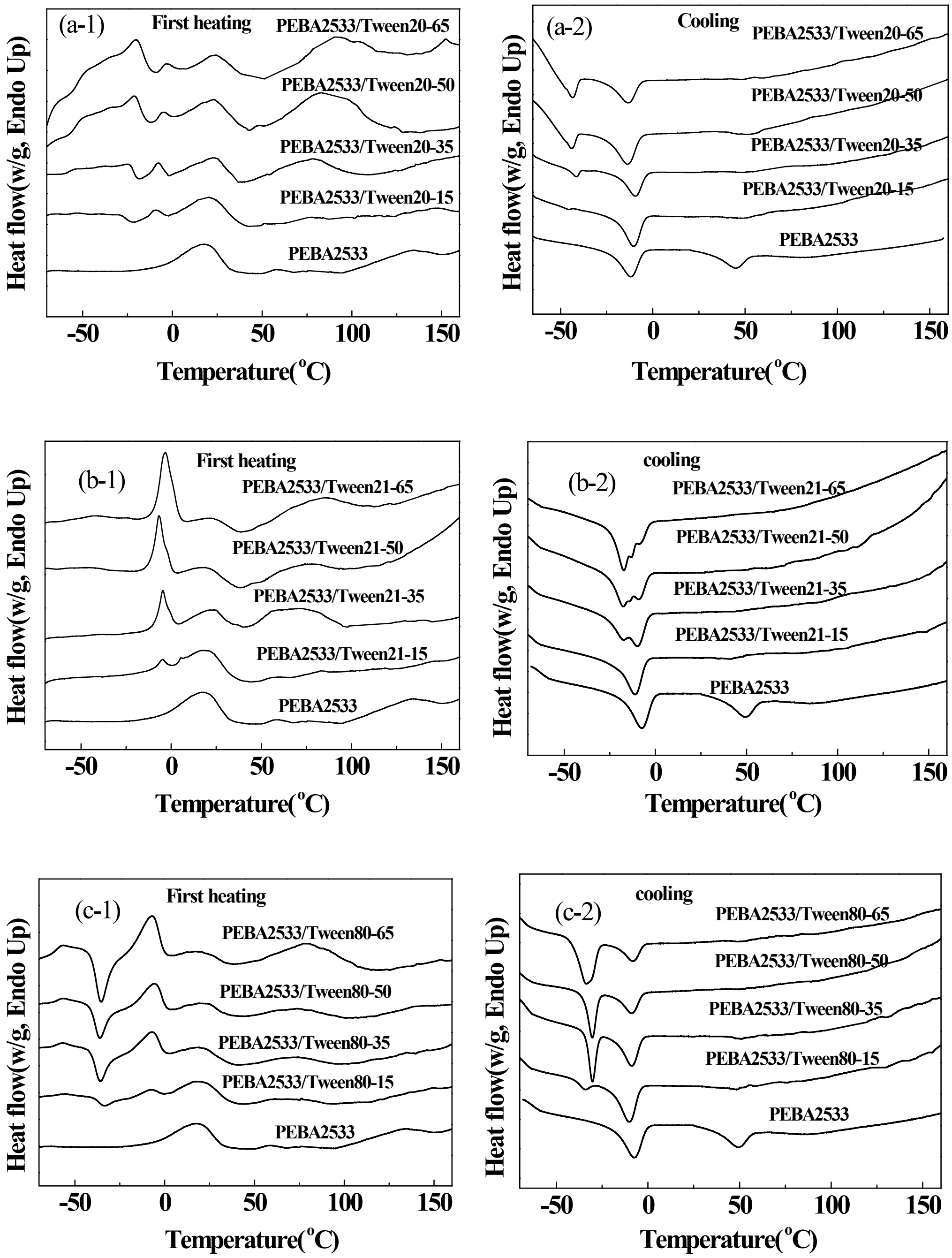

Fig. S3 DSC thermograms of the PEBA2533 and PEBA2533/Tween membranes (a): PEBA2533 and PEBA2533/Tween20 membranes (b): PEBA2533 and PEBA2533/Tween21 membranes (c): PEBA2533 and PEBA2533/Tween80 membranes

The neat PEBA2533 is a microphase-separated thermoplastic elastomer and has two dominant endothermic peaks as seen by DSC. The low temperature melting point, T_m (PTMO), is ascribed to melting of crystals of the polyether blocks and occurs about 0~20 °C. The high temperature melting point, T_m (PA), is attributed to melting of polyamide crystals and exists approximately 140~160 ^{o}C. During the first heating run for all PEBA2533/Tween gel membranes, there is a large peak appearing at about 80 ^{o}C and disappearing at the second heating run. This phenomenon is ascribed to the evaporation of humidity or residual solvent [1].

[1] R. A. Zoppi and C. G. A. Soares, *Adv. Polym. Tech.*, 2002, **21**, 2-16.