# Supplementary Material

# Preparation of polyethersulfone/magnesium silicate membranes via casting and electrospinning and their application in the removal of free fatty acids from biodiesel

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**Text S1.** Chemicals.

All the reagents and organic solvent used in this work, except for polyethersulfone and biodiesel, were purchased from Shanghai Chemical Reagents Co., Ltd. Polyethersulfone (Mw = 58,000 Da) was purchased from BASF (China) Co. Ltd, and was dried at 80°C for 24 h before usage. Crude biodiesel with high level of acid value was supplied by Qingdao Furuisi Technology Development Co., Ltd produced by using the waste frying oils. All chemicals were of analytical grade and directly used as received without further purification. The wasted reagents and solvents were collected and sorted then transported to the specified waste/wastewater disposal company for further treatment.

**Table S1.** Mass fractions of the components in the casting solutions.

| MS content in the composite membrane | casting solution composition (wt.%) | | |
|---|---|---|---|
| | MS | PES | organic solvent |
| 0 wt.% | 0 | 17 | 83 |
| 1 wt.% | 1 | 17 | 82 |
| 2 wt.% | 2 | 17 | 81 |
| 3 wt.% | 3 | 17 | 80 |

**Table S2.** Physical-chemical properties of the biodiesel.

| Parameter | Biodiesel |
|---|---|
| 20 °C Density/(kg/L) | 0.88 |
| 40 °C Kinematic viscosity/($mm^2/s$) | 3.0-8.0 |
| Acid value (mg KOH/g) | 2.39 |
| Close cup flash point/°C | >100 |
| Cetane number | >52 |
| Combustion efficiency (diesel=100%) | 104 |
| Sulphur content (mass fraction) /wt.% | <0.005 |

| | |
|---|---|
| Oxygen content (volume fraction) /vol.% | 10 |
| glycerol (mass %) | 0.35 |
| Water & sediment/vol.% | 0.20 |

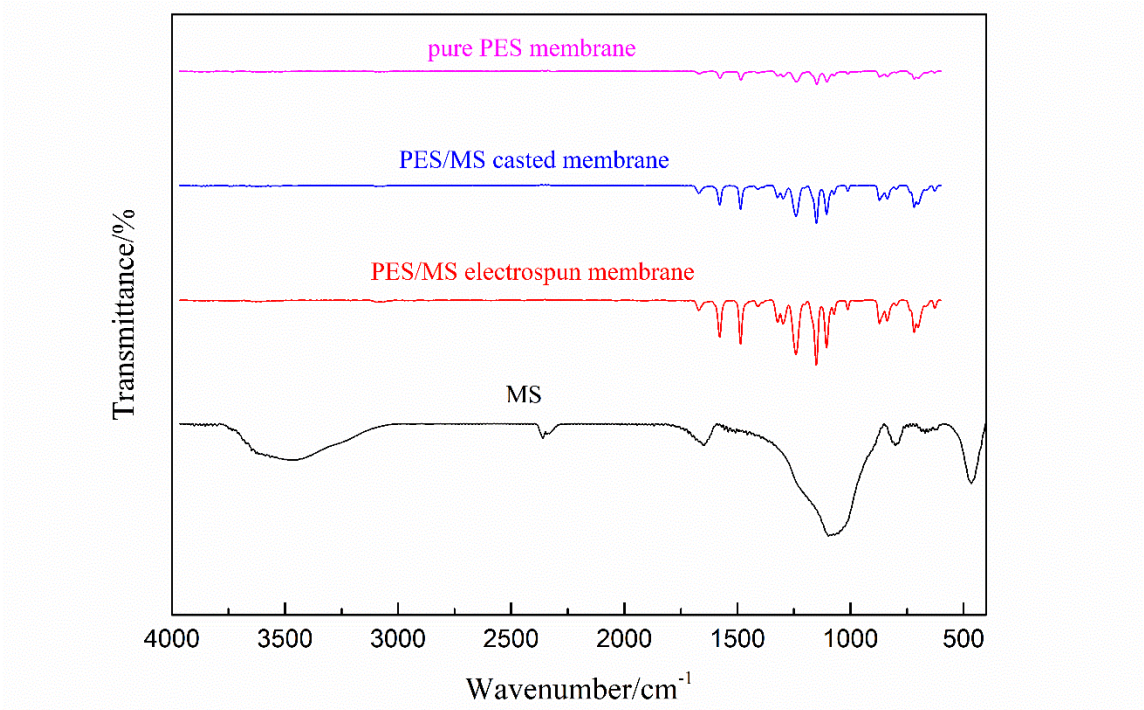


**Figure S1.** The FTIR spectra of MS, pure PES membrane, casted and electrospun PES/MS membranes.

**Table S3**. BET surface area, average pore size and average pore volume of the samples.

| Samples | BET surface area ($m^2$ $g^{-1}$) | Average pore size (nm) | Average pore volume ($cm^3$ $g^{-1}$) |
|---|---|---|---|
| Pure PES membrane (electrospun) | 57.29 | 5.543 | 0.3583 |
| MS | 590.3 | 5.432 | 0.5839 |
| PES/MS casted membrane | 502.4 | 4.714 | 0.6124 |
| PES/MS electrospun membrane | 646.3 | 5.491 | 0.7236 |

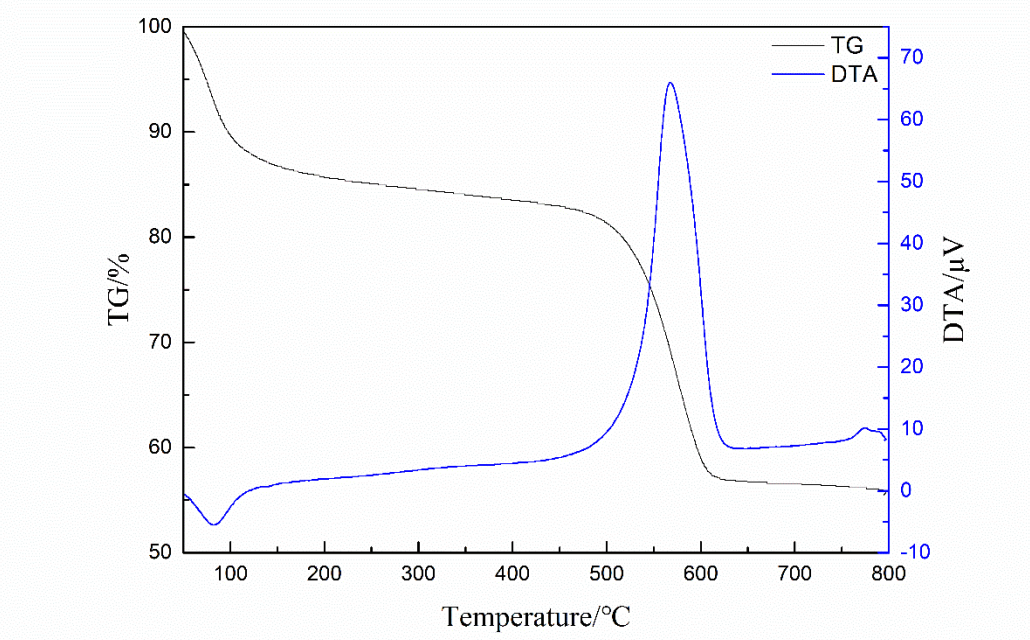


**Figure S2.** TG-DTA curves of the electrospun PES/MS membrane.

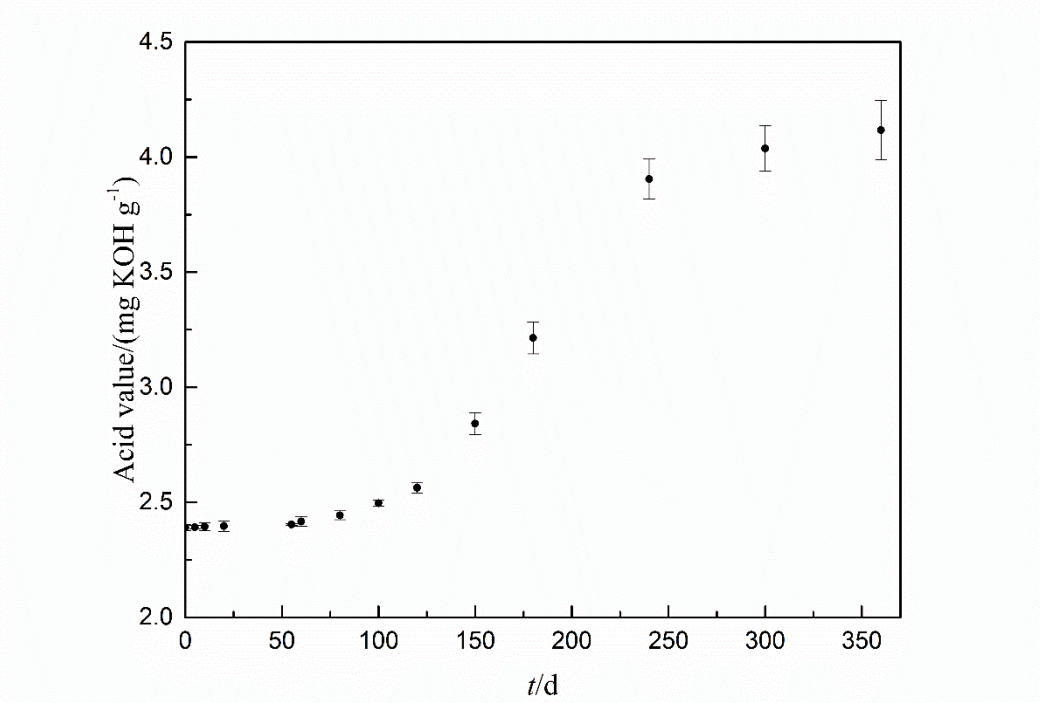


**Figure S3.** Acid values of the crude biodiesel during 350 days of storage.

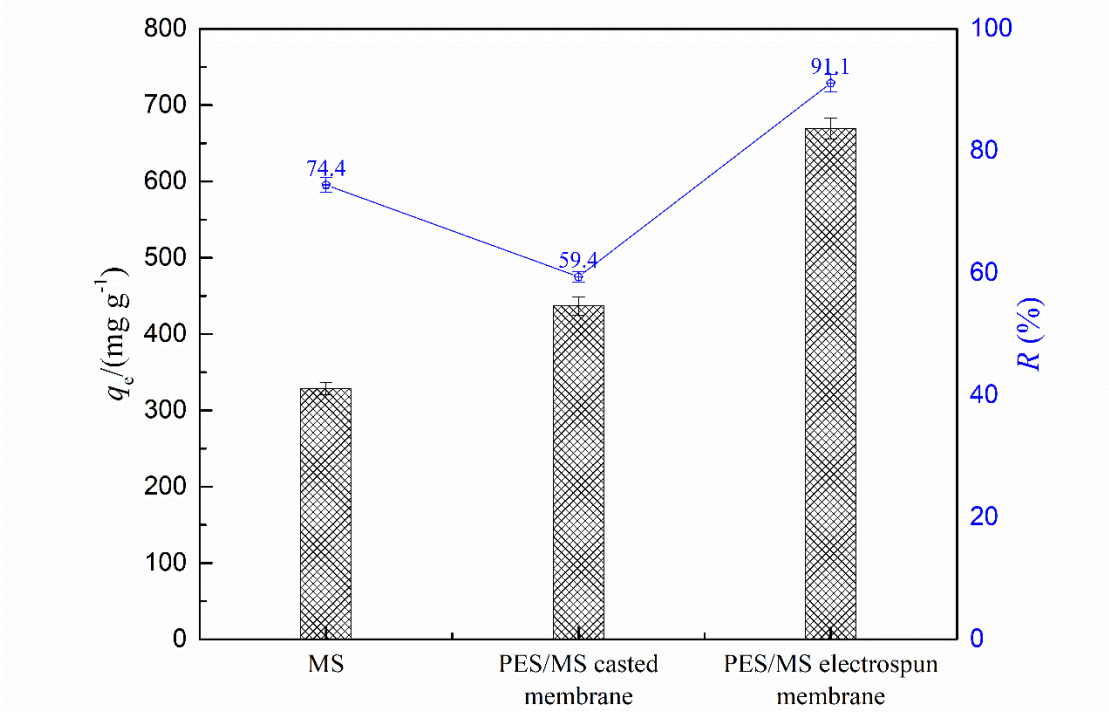


**Figure S4.** Equilibrium uptakes and removal efficiency of the FFAs on the powdery MS and casted and electrospun PES/MS membranes at 20 ℃.

**Table S4.** Rate parameters based on Weber-Morris intraparticle diffusion model for casted and electrospun PES/MS membranes.

| | casted membrane | | | electrospun membrane | | |
|---|---|---|---|---|---|---|
| T(℃) | $K_d$ (mg g$^{-1}$ min$^{-1/2}$) | C (mg g$^{-1}$) | $R^2$ | $K_d$ (mg g$^{-1}$ min$^{-1/2}$) | C (mg g$^{-1}$) | $R^2$ |
| 20 | 64.84 | -14.58 | 0.9973 | 157.5 | -0.927 | 0.9983 |
| 40 | 45.47 | -10.21 | 0.9968 | 143.3 | -0.649 | 0.9916 |
| 60 | 26.98 | -3.247 | 0.9960 | 85.05 | -55.04 | 0.9829 |

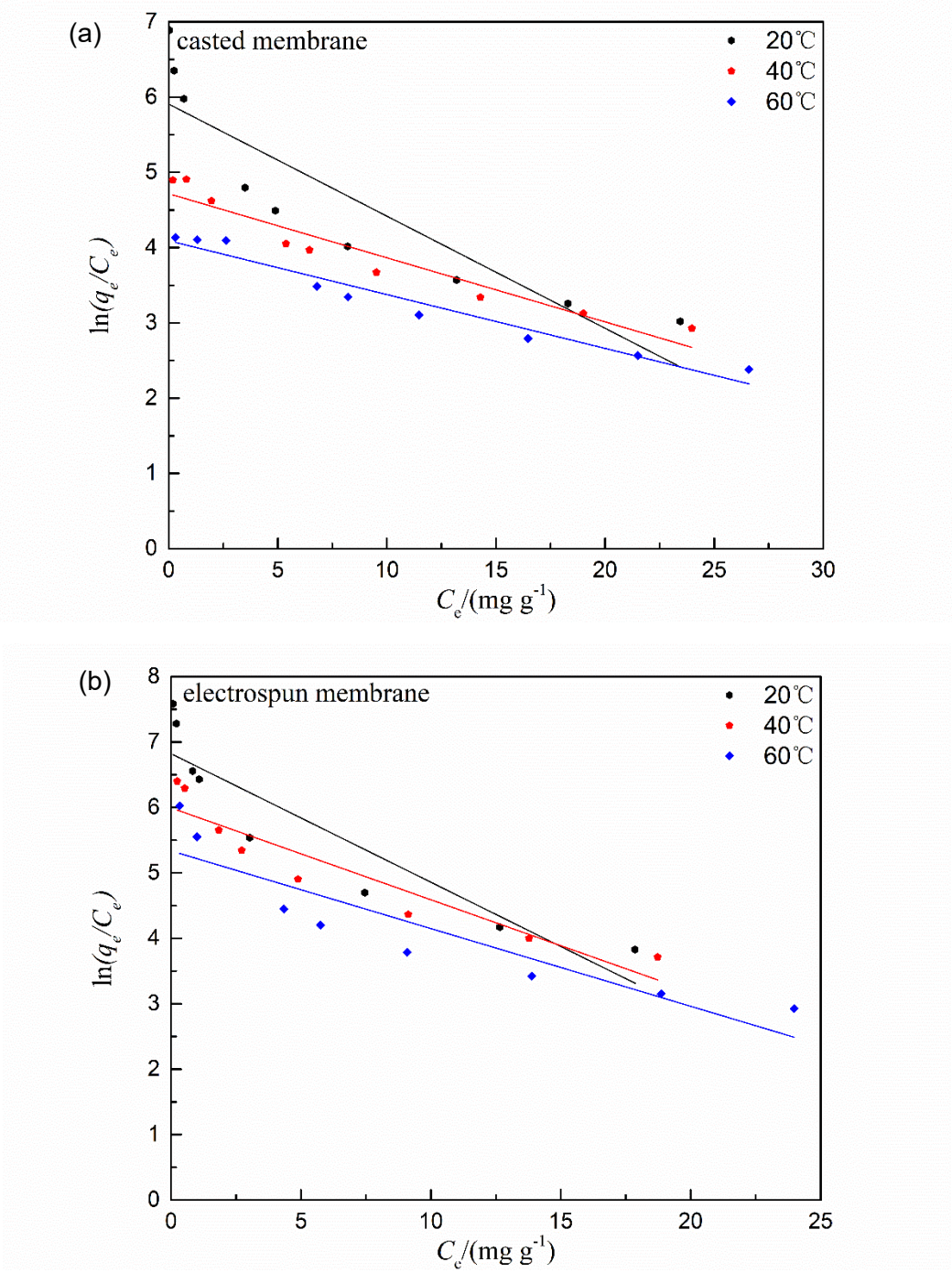


**Figure S5.** Plots for determination of $K_0$ values for FFAs adsorption onto the (a) casted and (b) electrospun PES/MS membranes.