

Fig. 1 Schematic of a PBO network and the influence of monomer ratio

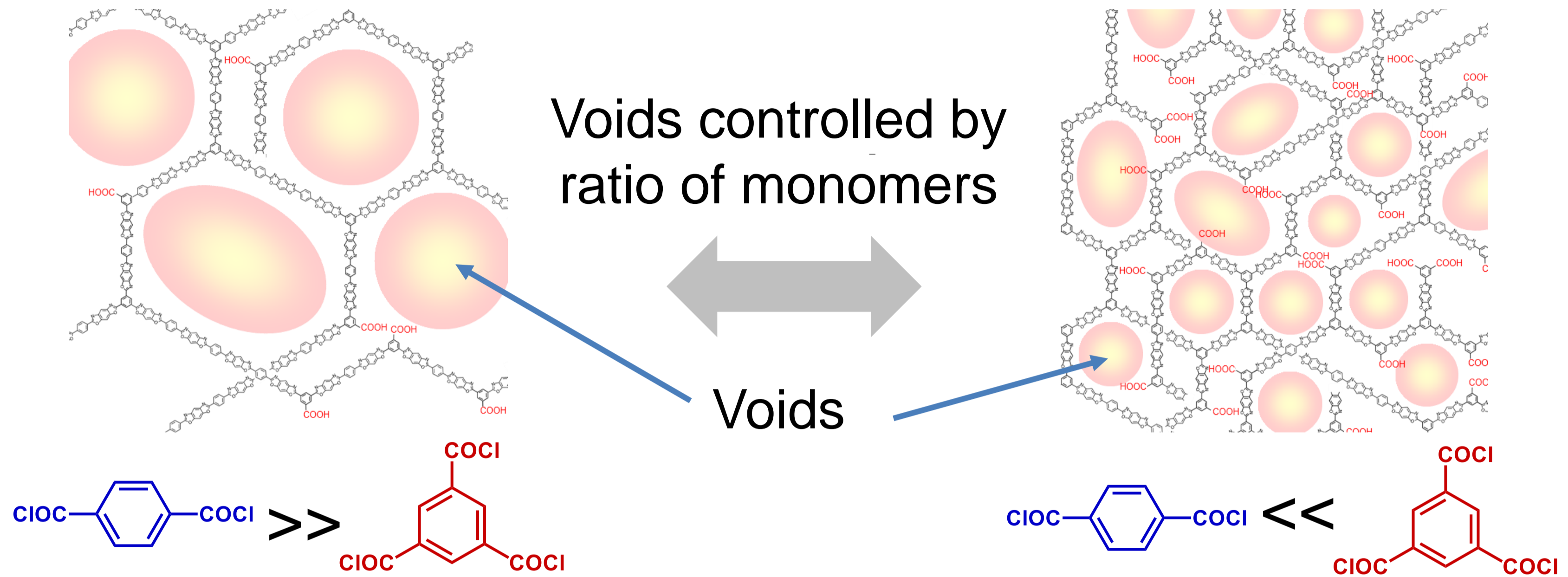


Fig. 2 Synthesis of TBS-DAR

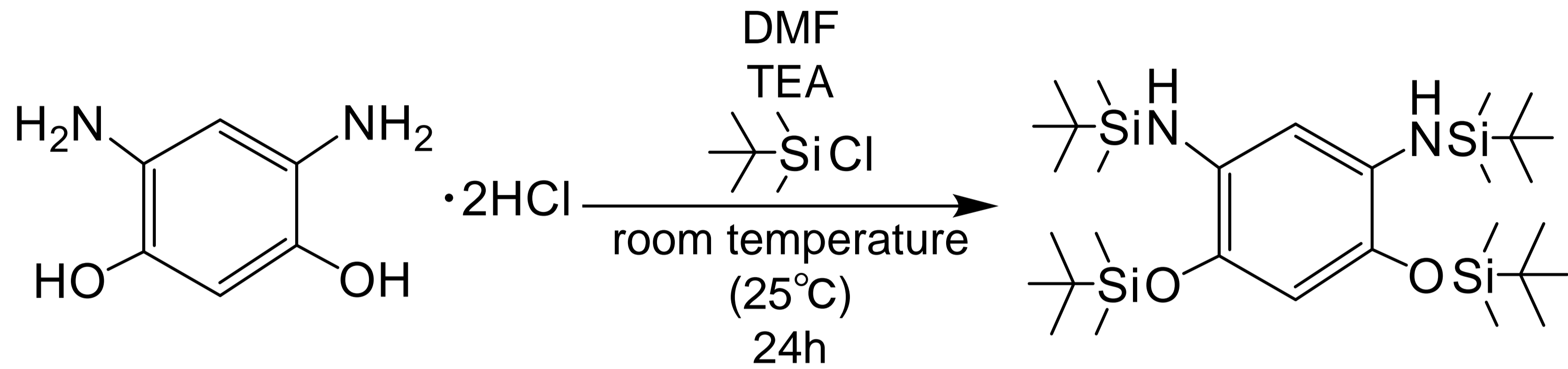
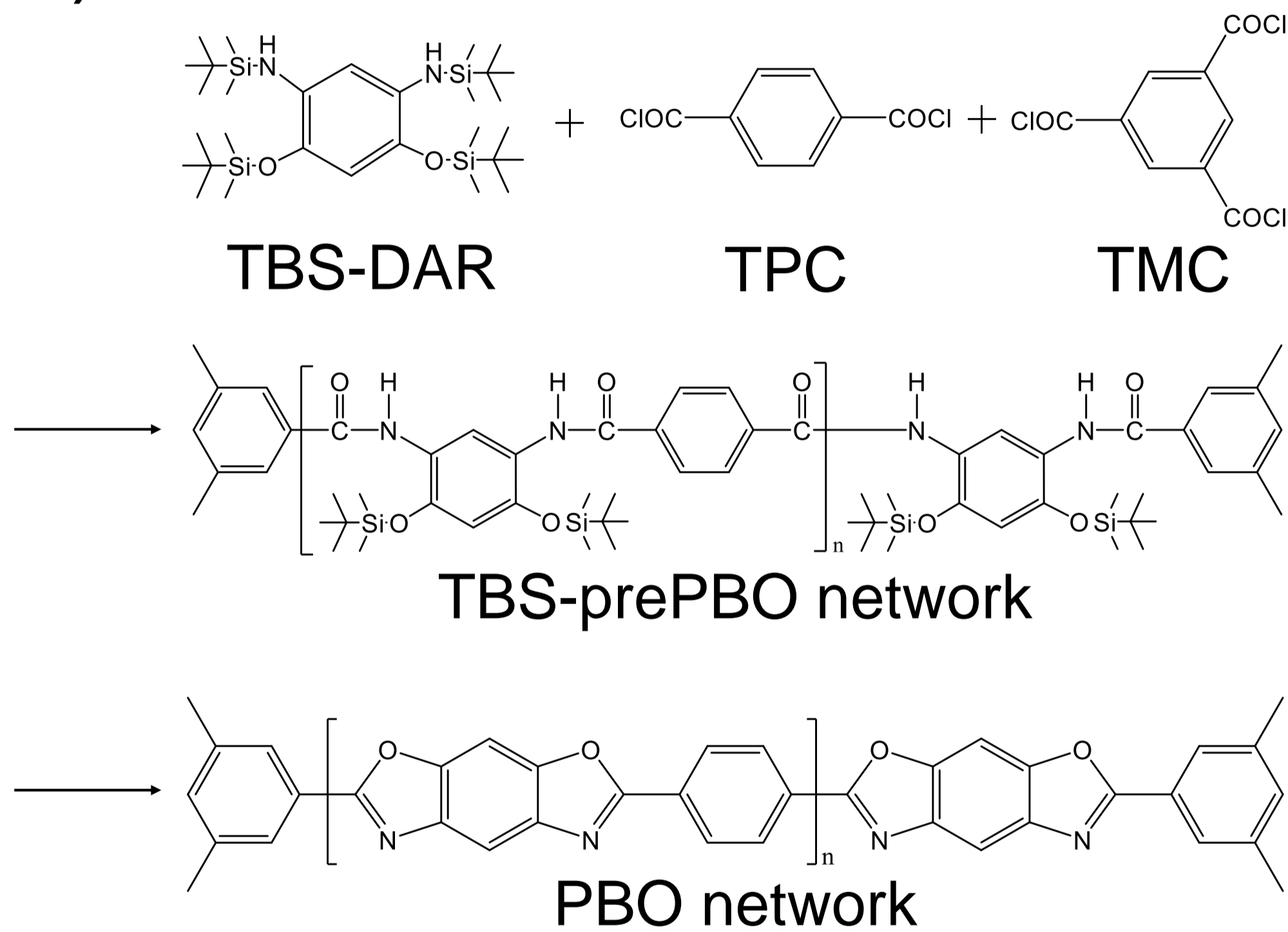


Fig. 3 Synthesis of a) PBO network and b) Pry-PBO network films

a)



b)

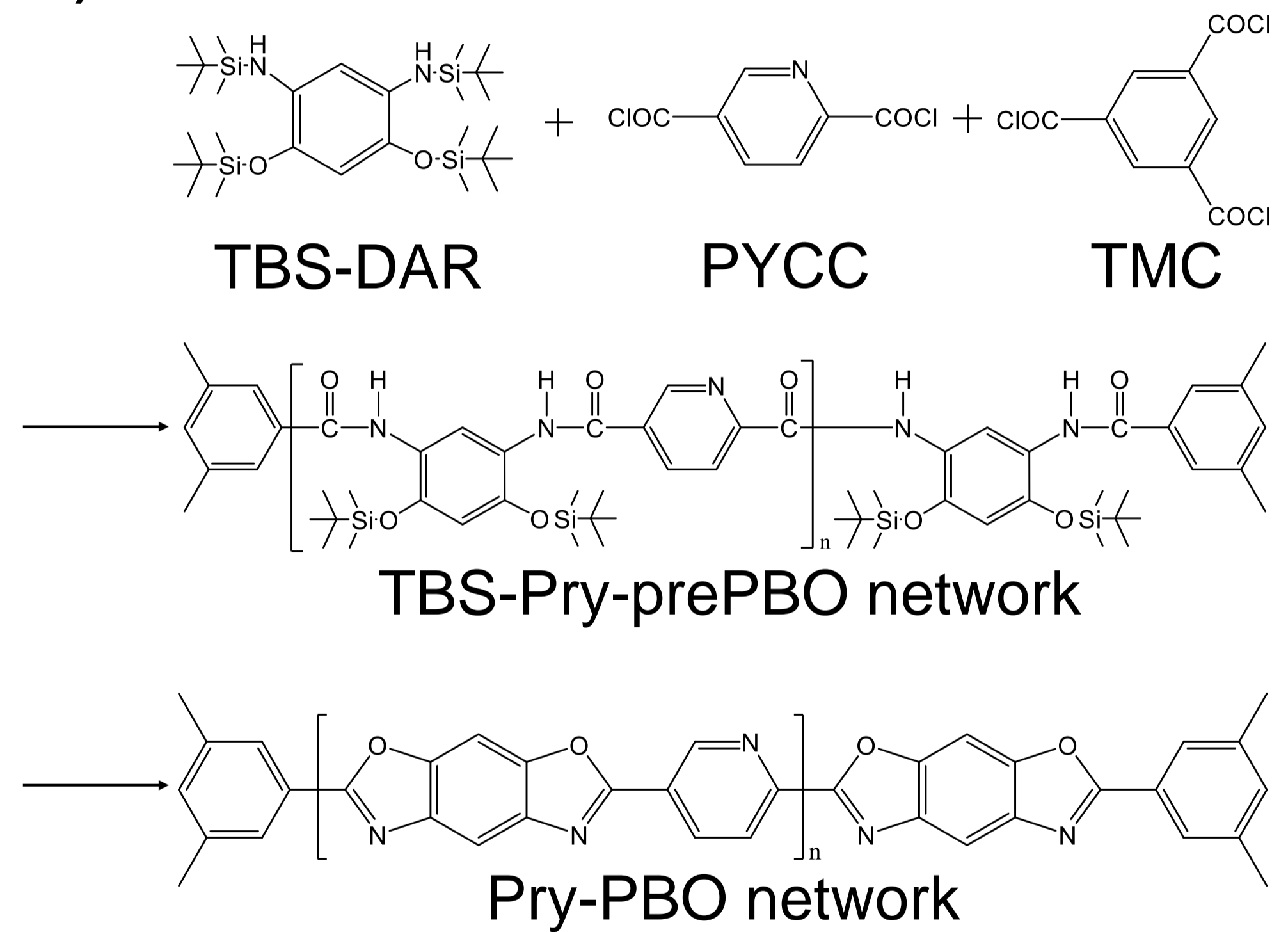
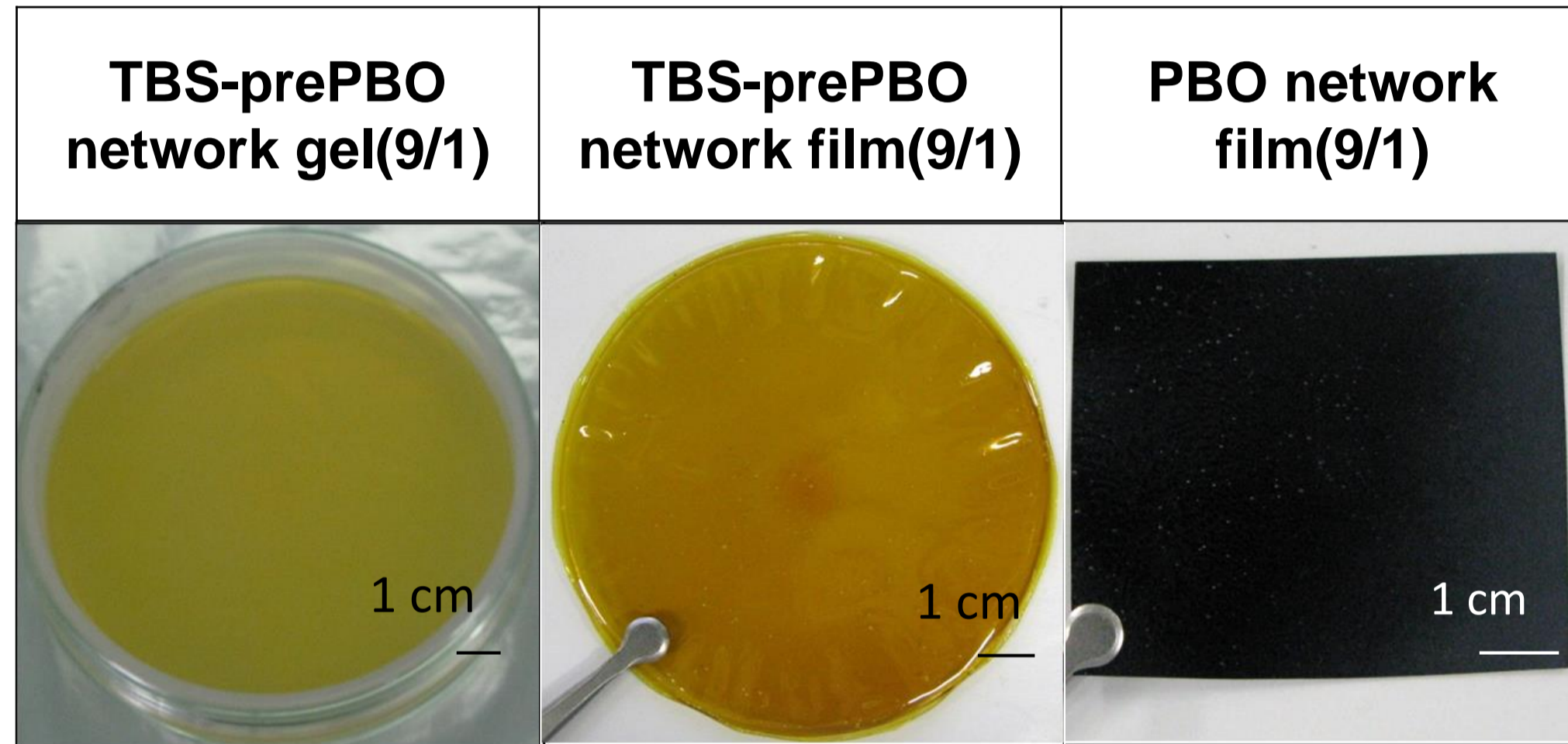


Fig. 4 Examples of a) PBO network and b) Pry-PBO network gels, pre-films, and films.

a)



b)

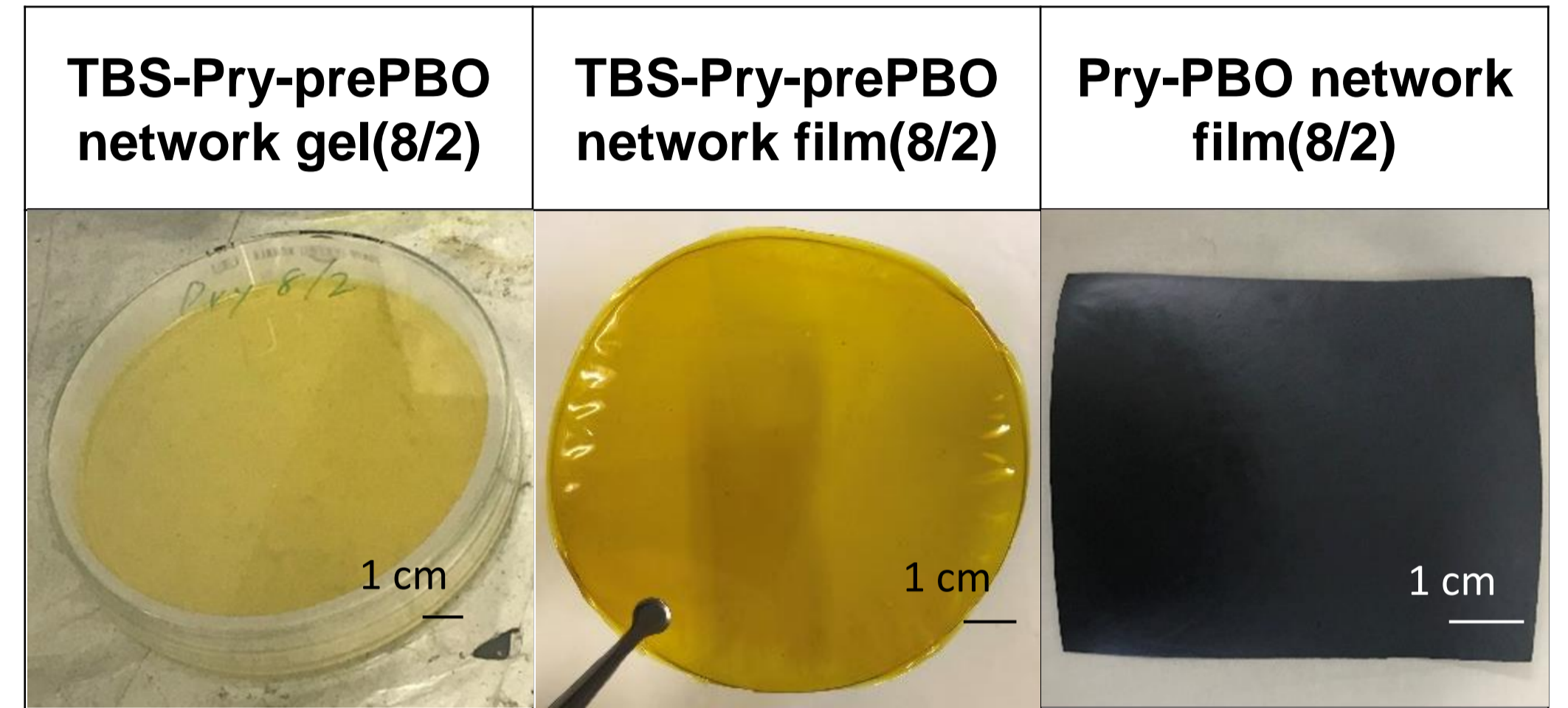


Fig. 5 Thermogravimetric analysis results for a) PBO network films and b) Pry-PBO network films.

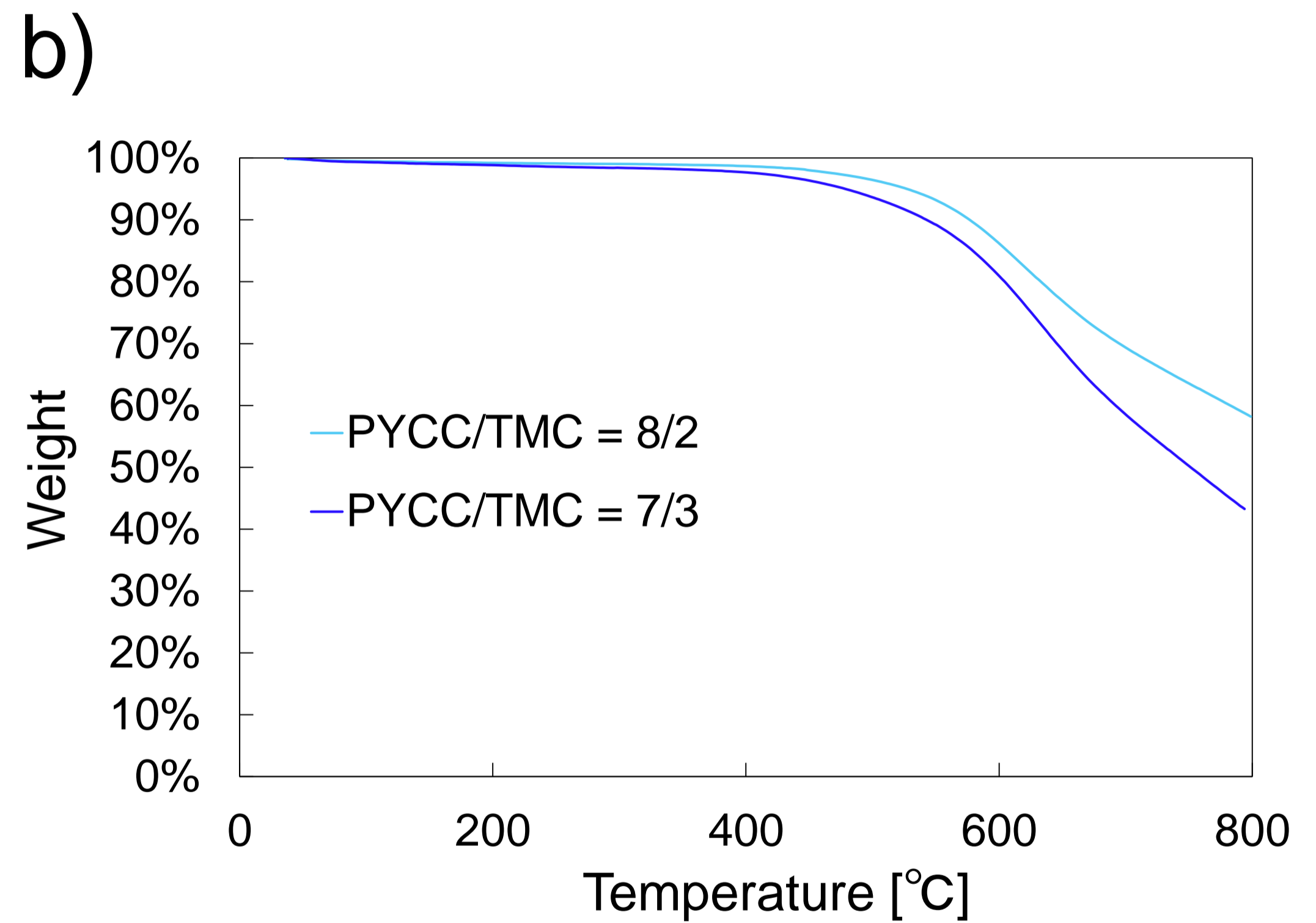
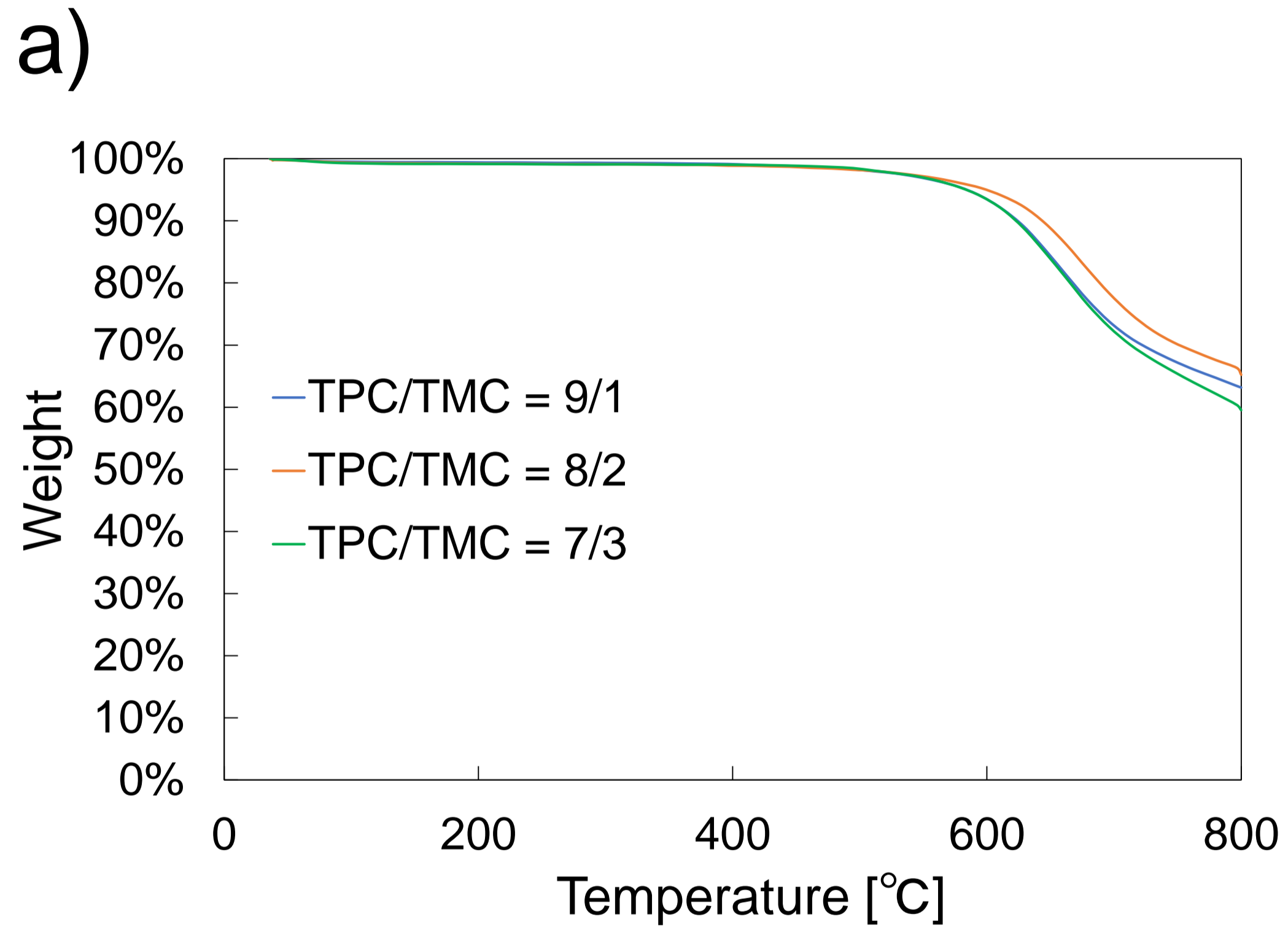


Fig. 6 Dynamic mechanical analysis results for a) PBO network and b) Pry-PBO network films.

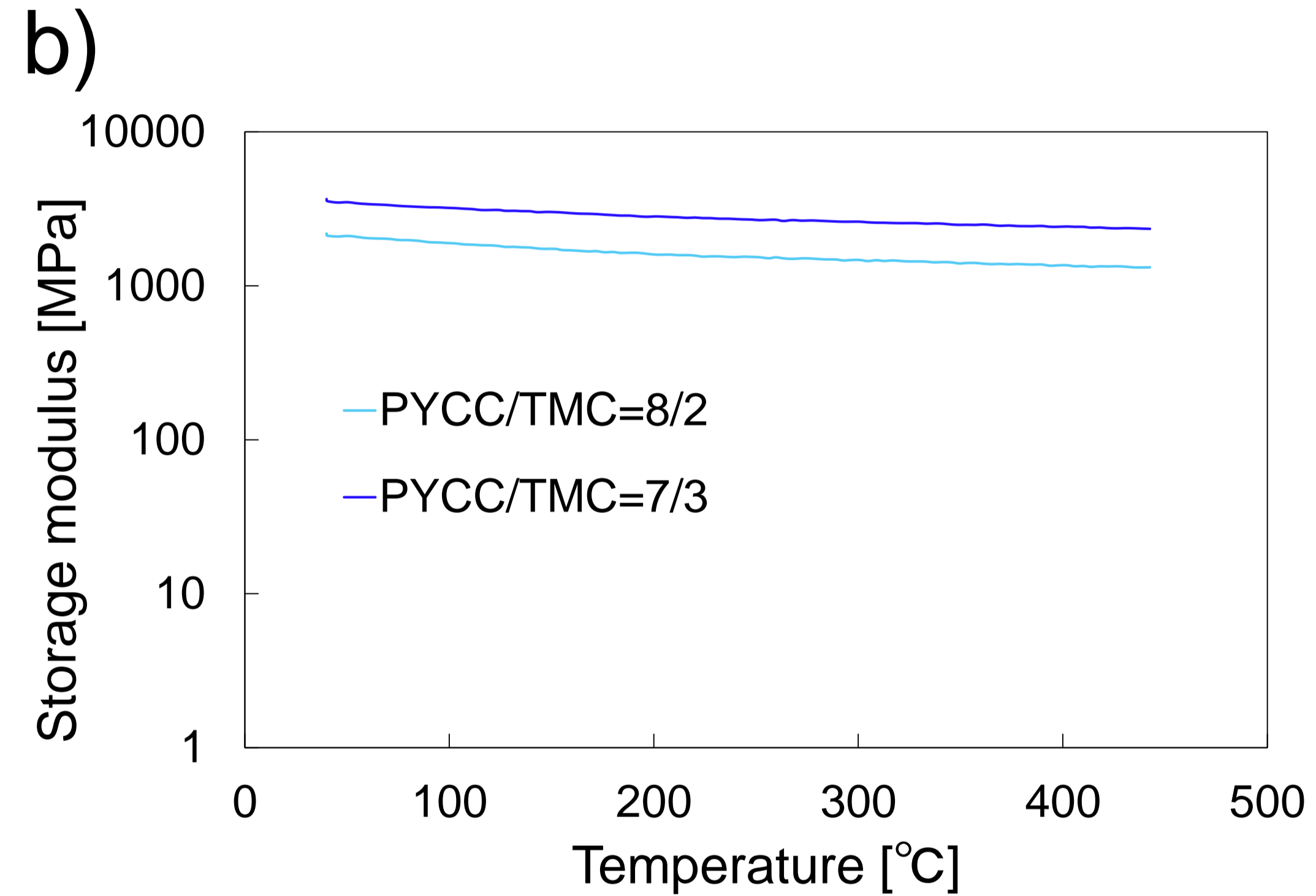
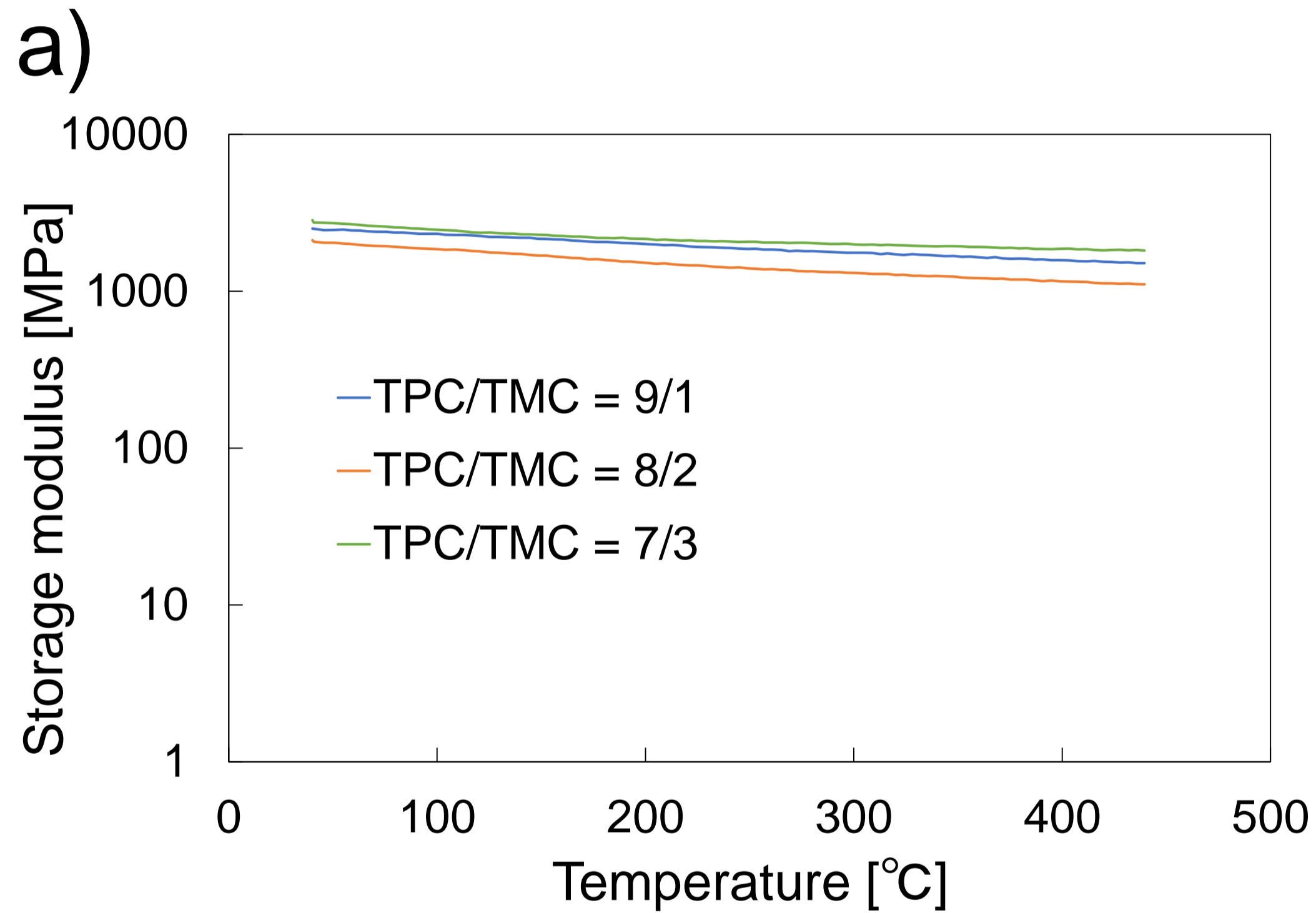


Table 1

	PBO network			Pry-PBO network	
TPC/TMC, PYCC/TMC	9/1	8/2	7/3	8/2	7/3
Apparent density (g/cm ³)	0.80	0.86	0.94	0.83	0.88
Porosity (%)	48	44	39	46	43
Modules (GPa)	1.40 ± 0.39	3.04 ± 0.19	2.15 ± 0.52	1.38 ± 0.18	0.91 ± 0.08
Breaking strength (MPa)	33.1 ± 4.89	83.5 ± 15.7	40.9 ± 10.8	25.5 ± 9.80	32.1 ± 13.9
Breaking elongation (%)	3.30 ± 0.59	4.67 ± 1.44	2.95 ± 1.41	2.69 ± 1.29	4.96 ± 1.86
Phosphoric acid / network*¹	3.7	3.5	2.9	3.2	3.0
PA doping level*²	9.0	8.4	6.9	7.7	7.2
Phosphoric acid / network*¹ of Methanol-washed film	1.5	1.5	1.4	1.6	1.2
PA doping level*² of Methanol-washed film	3.6	3.7	3.5	6.4	3.0

*1 The phosphoric acid contents was calculated with reference to the original film weight, using the following Equation.

$$\text{The phosphoric acid contents} = \frac{\text{The phosphoric acid doped film weight} - \text{The original film weight}}{\text{The original film weight}}$$

*2 The PA doping level was calculated using the following Equation.

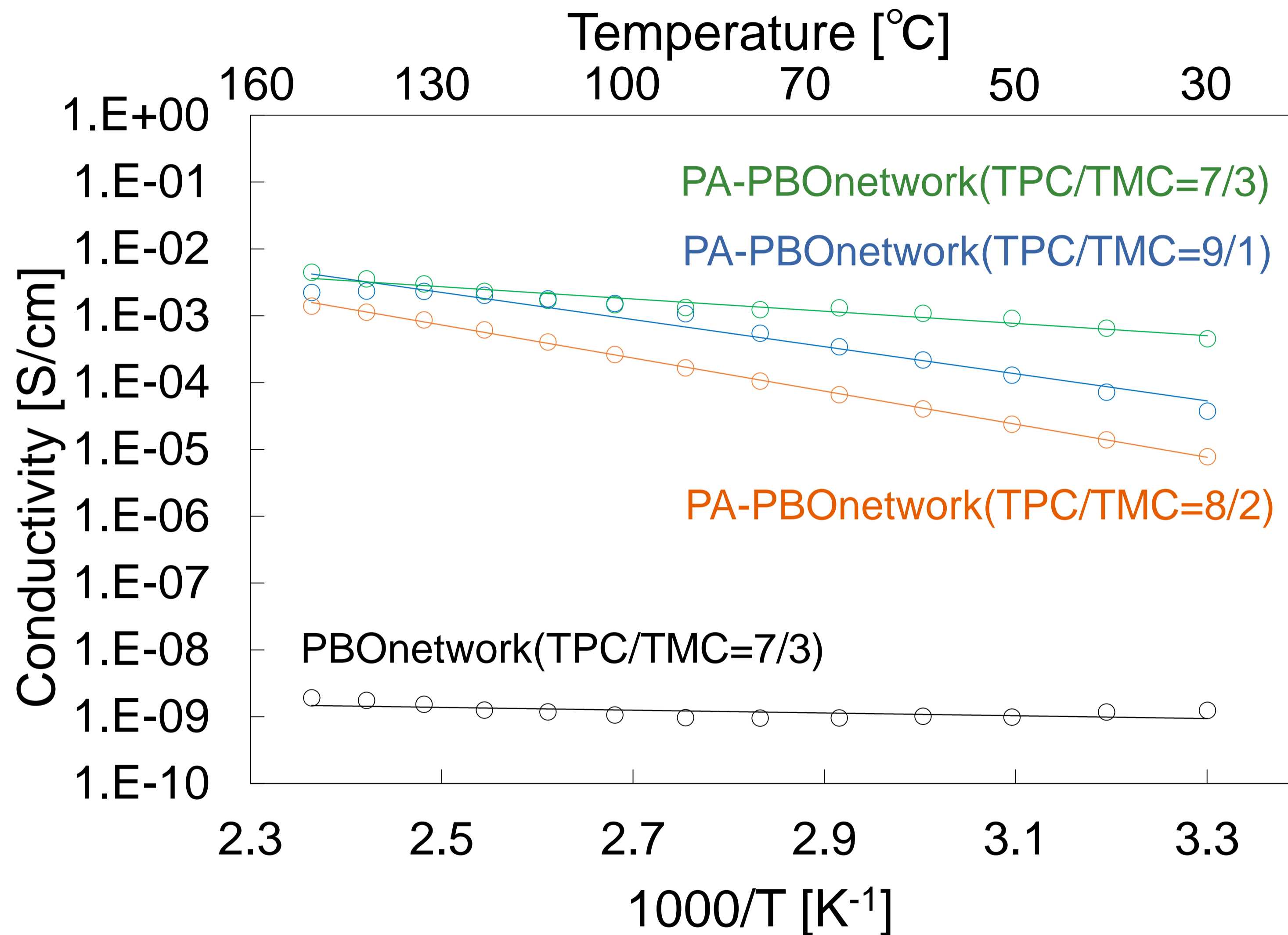
$$\text{The PA doping level} = \frac{\text{The phosphoric acid content weight}/98}{\text{The original film weight}/236.23 \text{ or } 237.22}$$

98 : molecular weight of phosphoric acid

236.23 : molecular weight of PBO unit

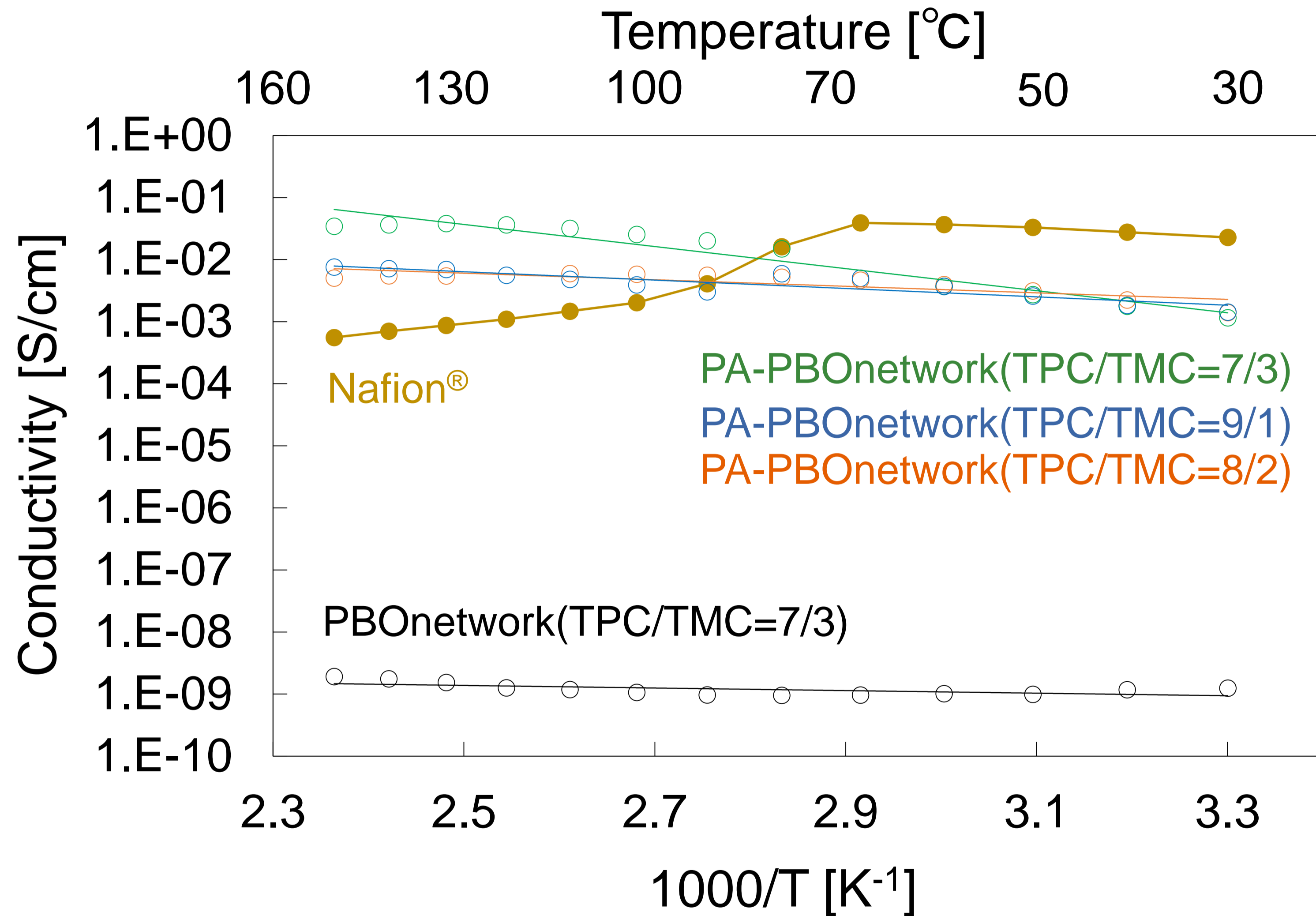
237.22 : molecular weight of Pry-PBO unit

Fig. 7 Conductivities of PBO network and methanol-washed PA-PBO network films.



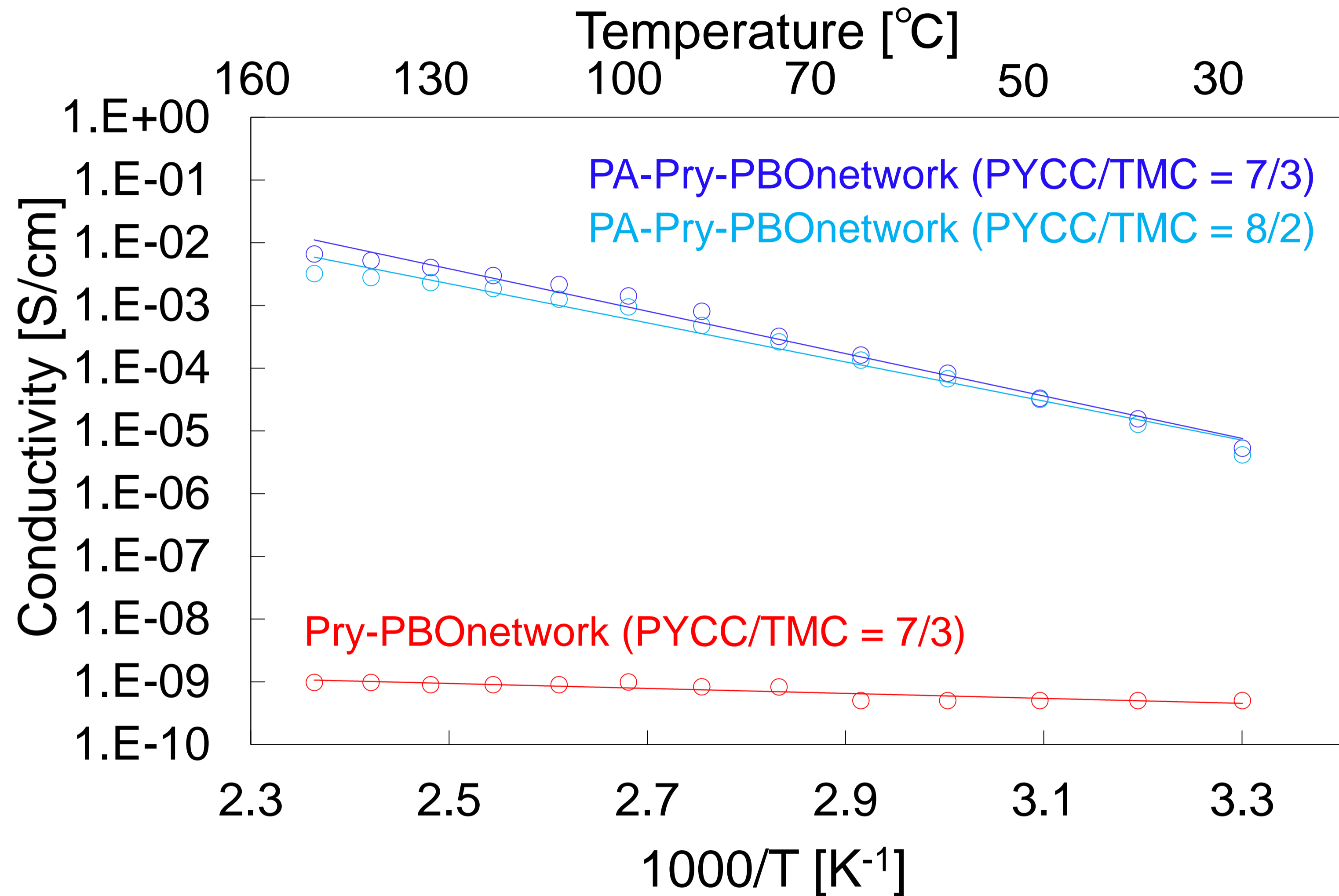
TPC/TMC	9/1	8/2	7/3
Activation energy (eV)	0.43	0.49	0.60
Activation energy (kJ/mol)	41	48	58

Fig. 8 Conductivities of PBO network film, PA-PBO network film, and Nafion[®].



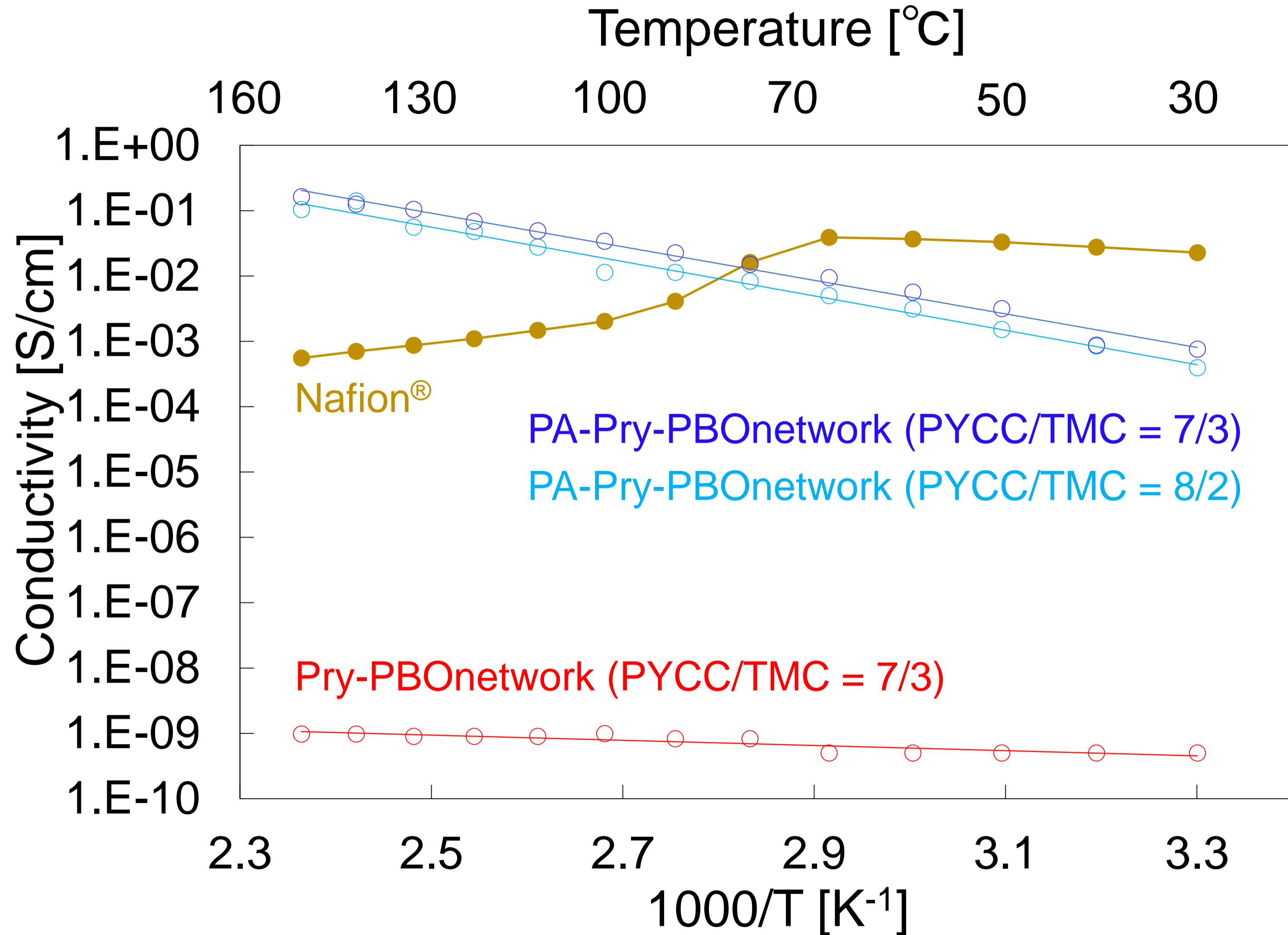
TPC/TMC	9/1	8/2	7/3
Activation energy (eV)	0.13	0.11	0.37
Activation energy (kJ/mol)	12	11	35

Fig. 9 Conductivities of Pry-PBOnetwork and methanol-washed PA-Pry-PBOnetwork (PYCC/TMC = 8/2 and 7/3) films.



PYCC/TMC	8/2	7/3
Activation energy (eV)	0.64	0.70
Activation energy (kJ/mol)	61	67

Fig. 10 Conductivities of Pry-PBOnetwork film, PA-Pry-PBOnetwork film (PYCC/TMC = 8/2, 7/3), and Nafion[®].



PYCC/TMC	8/2	7/3
Activation energy (eV)	0.51	0.49
Activation energy (kJ/mol)	50	47