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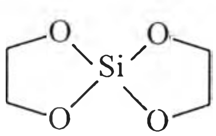
APPENDIX I

Theoretical calculation of % ceramic yield of purified monomers

From the combustion of a sample in TGA technique, it can be represented in eq. (A-1). Silica is the final product that left from the reaction, molecular weight of SiO_2 was used to calculate %ceramic yield, as shown in (A-2).



$$\xrightarrow{\Delta} SiO_2 + CO_2 + H_2 \qquad \text{(A-1)}$$

$$\%\text{Ceramic yield} = \frac{\text{MW of } SiO_2}{\text{MW of sample}} \times 100 \qquad \text{(A-2)}$$

The molecular weight of the sample can be calculated from the chemical formula obtained from chemical structure of product. For example, spirosilicate C2 product has chemical structure presented in eq. (A-1). The chemical formula of spirosilicate C2 is $Si(OCH_2CH_2O)_2$. Then %ceramic yield of spirosilicate C2 is

$$\%\text{Ceramic yield} = \frac{\text{MW of } SiO_2}{\text{MW of } Si(OCH_2CH_2O)_2} \times 100$$

$$= \frac{60}{148} \times 100 = 40.54$$

APPENDIX II

Calculation of Density of the Products

Density measurement for both monomers and polymers were studied using 25 ml pycnometer and distilled isooctane as a media at 25°C. The steps of density measurement are as followed;

the weight of sample = (A) g.

the weight of sample + isooctane = (B) g.

the density of isooctane at the set temperature obtaining from reference = (C) g/cm^3

the weight of isooctane = (B) - (A) = D g.

the volume of isooctane = D / (C) = E cm^3

the volume of sample = the volume of the bottle - E = G cm^3

then the density of sample = (A) / G g/cm^3

APPENDIX III

Finding the optimum conditions for curing the products

Table A-1 %Ceramic yields of spirosilicate C2 with varying temperature.

Temperature (°C)	%Ceramic Yield		
	1 st	2 nd	average
monomer	44.90	45.14	45.02
80	68.92	66.52	67.72
100	66.98	72.58	69.78
*120	75.17	75.09	75.13
140	77.94	75.74	76.84
160	77.43	80.53	78.98
180	80.05	78.83	79.44

*Suitable condition

Table A-2 %Ceramic yields of aminospirosilicate C3 with vary in temperature.

Temperature (°C)	%Ceramic Yield		
	1 st	2 nd	average
monomer	33.59	31.23	32.41
80	54.69	53.31	54.00
100	64.96	67.62	66.29
120	69.63	67.47	68.55
*140	71.64	73.90	72.77
160	74.56	72.20	73.38
180	72.44	74.90	73.67

Table A-3 %Ceramic yields of aminospirosilicate C4 with vary in temperature.

Temperature (°C)	%Ceramic Yield		
	1 st	2 nd	average
monomer	25.47	28.05	26.76
80	33.27	30.75	32.01
100	40.98	39.16	40.07
120	45.96	46.74	46.35
140	54.92	53.02	53.97
*160	66.96	68.82	67.89
180	67.92	67.54	67.73

Table A-4 %Ceramic yields of spirosilicate C2 with varying time at 120°C.

Time (hr)	%Ceramic Yield		
	1 st	2 nd	average
monomer	44.23	45.81	45.02
0.5	63.48	60.98	62.23
*1	74.55	73.07	73.81
2	74.22	72.76	73.49
3	74.47	76.51	75.49
4	76.68	75.00	75.84
5	75.59	75.65	75.62

Table A-5 %Ceramic yields of aminospirosilicate C3 with varying time at 140°C.

Time (hr)	%Ceramic Yield		
	1 st	2 nd	average
monomer	44.23	45.81	32.41
0.5	63.48	60.98	50.62
*1	74.55	73.07	72.77
2	74.22	72.76	71.77
3	74.47	76.51	73.24
4	76.68	75.00	74.50
5	75.59	75.65	74.96

Table A-6 %Ceramic yields of aminospirosilicate C4 with varying time at 160°C.

Time (hr)	%Ceramic Yield		
	1 st	2 nd	average
monomer	25.95	27.57	26.76
1	68.65	66.81	67.73
*2	71.05	72.99	72.02
3	73.32	71.08	72.20
4	71.44	73.62	72.53
5	71.84	72.54	72.19

Table A-7 Density results of the spirosilicate C2 product.

Sample	Density (g/cm^3)	
	Monomer	Polymer
1	1.7442	1.7478
2	1.7624	1.7887
3	1.6961	1.7187
average	**1.7342**	**1.7517**

Table A-8 Density results of the aminospirosilicate C3 product.

Sample	Density (g/cm^3)	
	Monomer	Polymer
1	1.6076	1.6269
2	1.6145	1.6388
average	**1.6111**	**1.6329**

Table A-9 Density results of the aminospirosilicate C4 product.

Sample	Density (g/cm^3)	
	Monomer	Polymer
1	1.5437	1.5673
2	1.5636	1.5602
average	**1.5537**	**1.5638**

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