The International Conference on Dyeing and Finishing
EXCO, Daegu, Korea, March 13, 2009

Polymerization of Tetraethoxysilane by using Remote Argon/dinitrogen oxide Microwave Plasma

Tae Il Chun and Volker Rossbach*

Dong-eui University, Department of Clothing & Textiles, Pusan 614-714, Korea.
E-mail: tichun@deu.ac.kr

*Dresden University of Technology, Institute of MacromoleculeChemistry and Textile Chemistry, D-01062 Dresden, Germany.
E-mail: Volker.Rossbach@chmie.tu-dresden.de

1. Introduction

Polymerization of tetraethoxysilane(TEOS) on a glass substrate by using Ar/N_2O microwave plasma was investigated. We have identified that the chemical structure of the samples by X-ray photon spectroscopy, Fourier transformed infrared spectroscopy, and scanning electron microscope combined with Energy dispersive X-ray spectroscopy

2. Experimental

The dense Argon/N_20 gas plasma was formed using a MW source of the SLAN I type based on the slot antenna principle (JE PLASMA CONSUL, GmbH, Germany, 2KW, 2.46GHz).

3. Results and Discussion

Figure 1 showed ATR spectra of the plasma/TEOS treated and untreated glass for comparison. XPS analysis showed that increasing plasma power and Ar/N_20 gas flow rate, Si atomic concentration increased

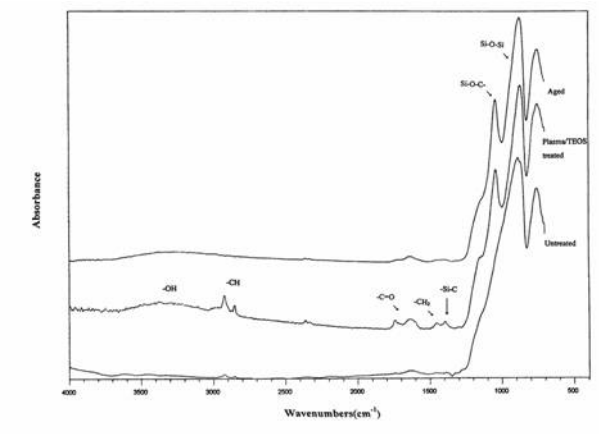

Fig. 1. FT-IR-ATR spectra of untreated and plasma/TEOS deposited glass

Table 1. Elemental composition in atomic % of plasma/TEOS treated samples

Atomic Species(%) / Plasma Power	C 1s	O 1s	N 1s	Si 2p
500 W *a*	68.31	20.93	0.62	8.56
1,000 W *b*	22.78	47.96	1.19	23.83

Treatment conditions: a and b the reaction time was 60min, the vacuum pressure 0.5 mbar, TEOS flow rate 0.05slm. *a* : 0.3 slm Ar / 8.75 vol % N_20, *b* : 1.0 slm / 8.75 vol % N_2O.

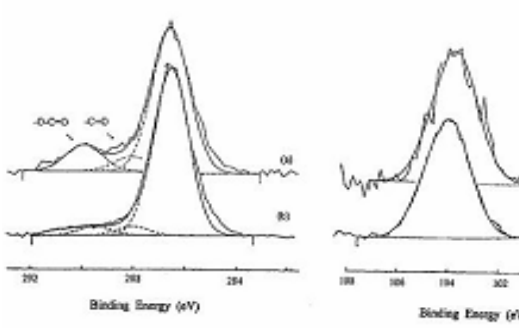

Fig.2. Xps Spectra of the surface of Plasma/TEOS deposited layers.

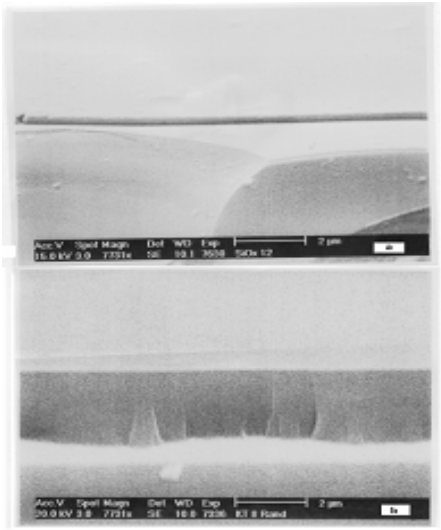

Fig.3. SEM of Plasma/TEOS deposited layer on the glass substrate.

Treatment conditions: Sample (a) and (b), the reaction time was 30min, TEOS flow rate 0.05slm; (a)0.2mb, 300W, 0.3 slm Ar/8.75 vol % N_2O, (b)0.5mb, 200W, 1.0 slm Ar/8.75 vol %N_2O.

and aliphatic carbons decreased(see Table 2 and Fig.2). The existence of carbon based organic structure containing silicone oxide as suggested. SEM of samples are shown in Fig. 3. The EDXS spectra in Fig.4 and Table 1 showed the chemical composition of the layer. Three peaks typical for C, O, and Si appeared.

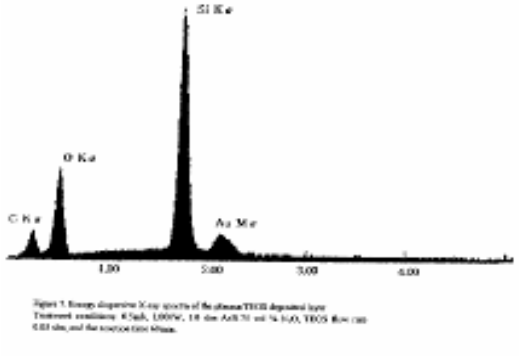

Fig. 4. Energy dispersive X-ray spectra of the Plasma/TEOS deposited layer.

Treatment conditions: 0.5 mb, 1,000 W, 1.0slm Ar/8.75 vol% N_2O, TEOS flow rate 0.05slm and reaction time for 60min.

Table 2. Carbon Species in Atomic % of plasma/TEOS deposited samples.

Binding Energies / Plasma Power	C-species		
	C-C, C-H 285.0eV	C-O 286.5 eV	NH-C=O, -O-C=O 288eV
500 W ***a***	60.87	4.19	3.64
1,000 W ***b***	17.79	1.78	3.21

a and ***b*** conditions are see Table 1.

4. Conclusion

Transparent layer as a thickness of 0.5 μm - 3 μm obtained. We have identified that the chemical structure of samples composed of mainly Si-O- and Si-C- groups containing aliphatics, carbonyl groups and also small amount of nitrogen. The existence of carbon based organic structure containing silicone oxide was suggested.

5. References

[1]Hans R. Kricheldorf, Silicon in Polymer Synthesis, Springer-Velag , Berlin, Chapter 7, .408, 1996.

[2] Tae Il Chun, Suk Chul Choi, Christine Täschner, Albrecht Leonhardt, Robert Kaufmann, Carsten Rehwinkel, Volker Rossbach, *J. Appl. Poly. Sci.*, 76, 1207, 2000.