Textile Sensor for pH Detection using Azo Colorants

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1. INTRODUCTION

The system for detecting the change of pH is important not only in the research area such as environmental, medical, and industrial section but also in our daily life. Therefore, a lot of studies have been conducted for pH detecting method for a long time. However, this method which measures color change of solution using machine has disadvantages; very complex procedure of machine manufacture, and lack of flexibility and mobility. Therefore, textile sensor for pH detection which makes up for this disadvantage has received attention.

Environmental textile sensor for pH detection is defined as a textile which is actively react with pH and show the information to user by adding optical and electrical characteristics into its own chemical, physical characteristic.

2. EXPERIMENTAL

2.1 The synthesis of colorants

Azo colorants which have similar structure with congo red used as pH indicator was synthesized to apply similar mechanism with congo red. As congo red is composed of benzidine structure, it is quite harmful for human and environment. Therefore, azo colorants which don't have cancerogenic effect was synthesized using 2,2' –dimethyl -5.5'- dipropoxy-benzidine and 5.5'-dipropoxybenzidine.

2,2'-dimethyl-5.5'-dipropoxybenzidine and 5.5'-dipropoxybenzidine were diazotized in the presence of HCl and $NaNO_2$ solution followed by adding coupler solution (Naphthionic acid & Laurant's acid) at the range of pH 4~5. The structure and synthesis of azo colorants was shown in Fig. 1

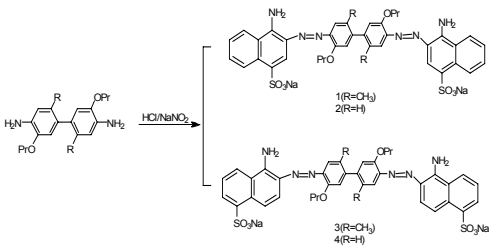
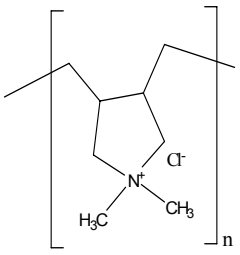


Fig. 1. Synthesis of azo colorants.

2.2 The application of textile

Synthesized colorant was applied to textile by layer-by-layer self-assembled multilayer (LBL) method. LBL method is explained that textile alternately absorb excess cationic solution and anionic solution; in other words, multi-layer was made on the textile with each layer of opposite charged ion.

The structure of PDDA used as polyelectrolyte is shown in Fig. 2 and LBL method is simply shown in Fig. 3.



PDDA

Fig. 2. Chemical structure of PDDA.

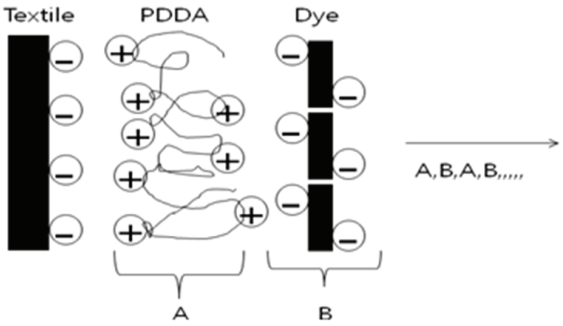


Fig. 3. LBL diagram which is composed of anionic textile, colorant and cationic PDDA.

3. CONCLUSION

The color change of solutions with various pH by synthesized colorants were investigated in detail using UV-Vis spectroscopy. The color change of textile applied colorants by pH was also investigated using photospectroscopy.

The four kind of previously mentioned colorants

show color change by pH not only at colorant solution but also on textiles. Fig. 4 indicates the color change of colorant solution 1 and 3 by using UV-Vis spectroscopy and Fig. 5 indicates the color change of textile applied colorant 2 and 4 after reacting with acid by using photospectroscopy.

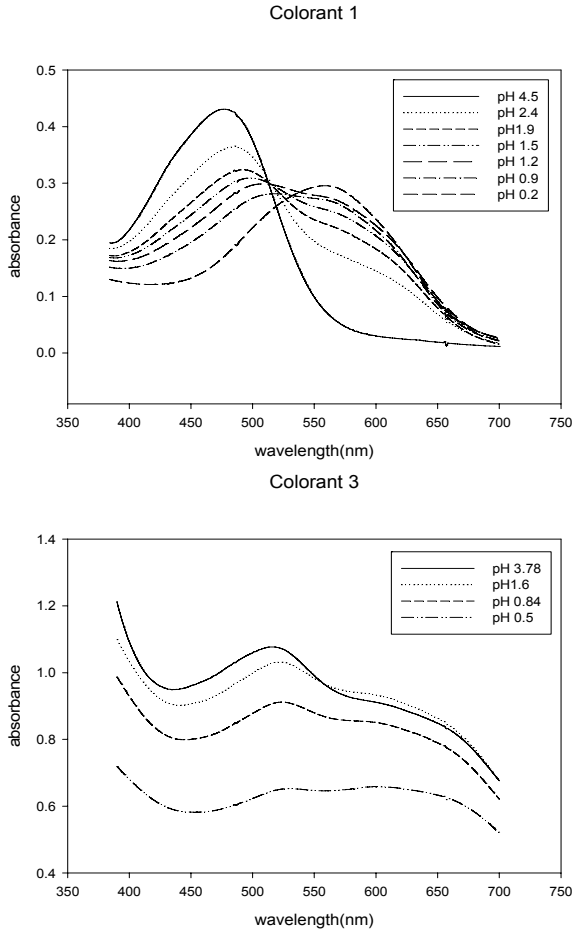
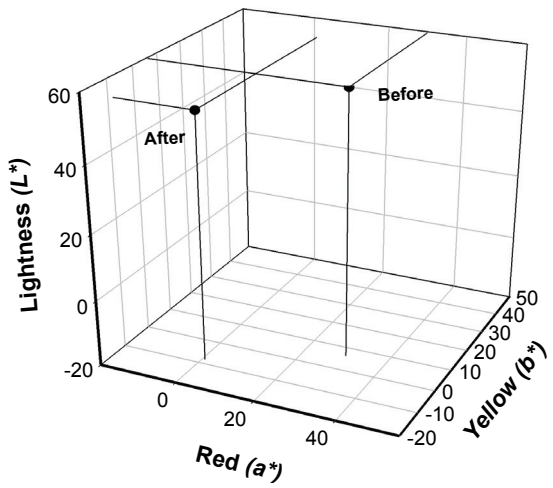


Fig. 4. Color change of colorant solution 1 & 3



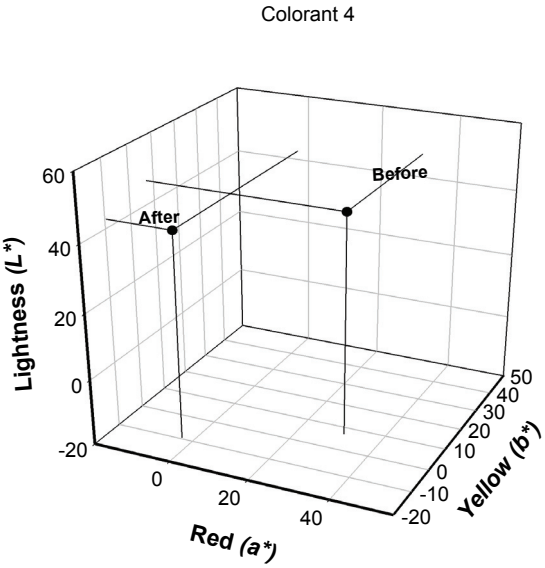


Fig. 5. Color change of textile applied colorant 2&4

4. REFERENCE

[1] Henesey F. *J Soc Dye colour*, 54, 105(1938).
[2] Decher G, Hong J D. *Makromol Chem Macromol Symp*, 46, 321(1991)
[3] Decher G. *Science*, 277, 123(1997)
[4] Schmitt J, Decher G, Dressik WJ, Brandow SL, Geer RE, Shashidbar R., *adv Mater*, 9, 61(1998)
[5] Gao MY, Richter B, Kristein S, Mohwald H, *J Phys Chem B,* 102, 4096(1998)
[6] Kaschak DM, Mallouk TE. *J Am Chem Soc*., 118, 4222(1996)
[7] Freeman, H. S., Hinks, D. and Sokolowska Jolanta, *Dyes and pigments*, 44, 199(2000)