# Reactive anion agent for Durable Nanosilver finish of Cellulose fiber and Its Antibacterial Activity

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## 1. INTRODUCTION

Using γ-irradiation - induced reduction in the field of a $^{60}Co$ γ-ray source, colloidal silver was prepared from different polymer reducer(PVP, SDS, PEG) in aqueous solution which compared with those by different intense γ-irradiation. And γ-irradiation induced colloidal silver sol compared with chemical reduction.

The silver nano particles prepared by different reducer were characterized by UV-VIS spectro-photometer and transmission electron microscopy (TEM). The radiation-based method provided silver nano particles with more stabilization and narrow size distribution than those obtained by chemical reduction method.

This article suggested how to increase an antifungal durability with coating a silver nano particle which is produced by γ-irradiation on a cellulose fiber. We used reactive anion agent to boost a coherence of the fiber and the silver nano particle. It helps a packing effect of the silver on the fiber strongly, so an efficacy of the silver can be persistent after washing and it continuously has antibacterial activity.

## 2. EXPERIMENTAL

### 2.1 Manufacturing of reactive anion agent

Reactive anion agent was composed sodium carbonate, cyanuric chloride and sulfanilic acid. It keeps condition of pH1~2 in low temperatures below 5 degrees and then sodium carbonate was added to the chemical compound.

### 2.2 Manufacturing of nano silver colloid


**Fig. 1.** Manufacture process of Colloidal silver sol

### 2.3 Treatment process of nano silver on fiber

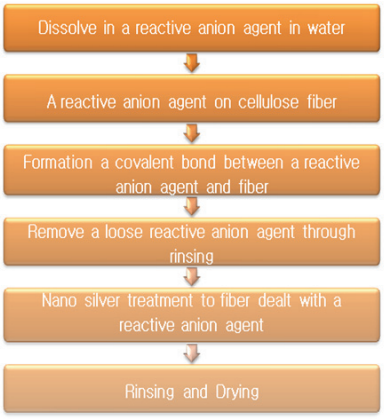



**Fig. 2.** Nano silver processing of cellulose fiber

## 3. Results and Discussion

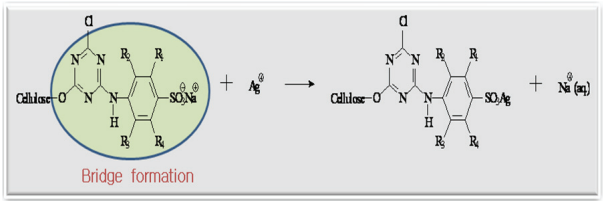



**Fig. 3.** Process of ion bond between silver nano particle and cellulose fiber treated by Reactive anion agent

**Table 1.** Silver nano particle size along radiation strength

| | 10KGy | 20KGy | 30KGy | 40KGy |
|---|---|---|---|---|
| ADD IPA | X | 20nm | 15nm | 12nm |
| NO IPA | X | 15nm | 12nm | 7nm |

**Table 2.** Silver nano particle size along electron strength

| | 10KGy | 30KGy | 50KGy |
|---|---|---|---|
| ADD IPA | X | X | 14.4nm |
| NO IPA | 20nm | 7.2nm | 10nm |

**Table 3.** Silver nano particle size along irradiation

| | 10KGy | 30KGy | 40KGy |
|---|---|---|---|
| ADD IPA | 12nm | 10nm | 7nm |
| NO IPA | X | X | 20nm |

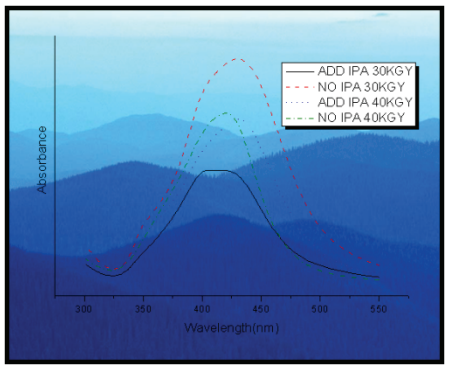
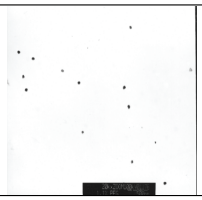
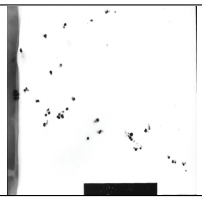



**Fig. 4.** UV spectra along radiation strength

Average size of silver nano particle depends on different polymer reducing agent.

| Reducer | PVP(NO IPA) | SDS(NO IPA) |
|---|---|---|
| TEM image |  |  |
| Particle size | 12 nm | 27nm |

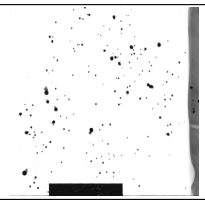
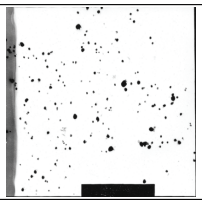
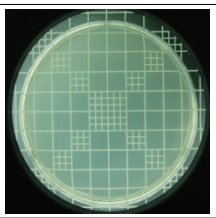
| Reducer | PVA(NO IPA) | PEG(NO IPA) |
|---|---|---|
| TEM image |  |  |
| Particle size | 17 nm | 100nm |

**Fig. 5.** Silver nano particle sizes along different reducers


Staphylococcus aureus

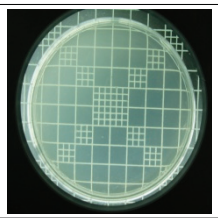
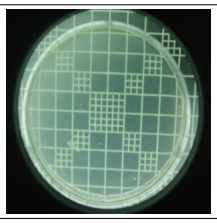

Klebsiella pneumoniae

**Fig. 6.** Test for antibacterial of textiles (KS K 0693) - Washing durability


Staphylococcus aureus

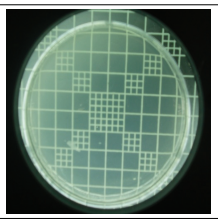

Klebsiella pneumoniae

**Fig. 7.** Test for antibacterial of textiles (KS K 0693)- Storage stability

## 4. CONCLUSION

Isopropylalcohol(IPA) used to scavenger at the γ-irradiation-induced silver colloid. And if IPA added, silver colloidal solution uniform and stabilized. Also size of silver nano particles are smaller than no added IPA. But in the case of electron gun-induced silver colloid not make silver particle when added IPA. Therefore, when we used various polymer (PVP, SDS, PEG, PVA) for reducer, PVP (poly-vinylpyrrolidone) is the best.

In the case of simple adsorbed silver nano particle on cotton fiber, which were easy desorbed after 10 times washing. But when we used reactive anion agent, which boost a coherence of the fiber and the silver particle.

Reactive anion agent helps a packing effect of the silver on the fiber strongly, so an efficacy of the silver can be persistent after 10 times washing. And also those have perfect antifungal.

## 5. REFERENCES


[1] Chen Y, Wang L, Jiang S, Yu HJ. 2003. Study on novel antibacterial polymer materials (I) preparation of zeolite antibacterial agents and antibacterial polymer composite and their antibacterial properties.J Polymer Mater 20:279–284.

[2] Lee HJ, Yeo SY, Jeong SH. 2003. Antibacterial effect of nanosized silver colloidal solution on textile fabrics. J Mat Sci 38:2199–2204.

[3] Nair AS, Pradeep T. 2004. Reactivity of Au and Ag nano particles with halocarbons. Appl Nanoscience (in press).

[4] Sondi I, Salopek-Sondi B. 2004. Silver nano partic les as antimicrobial agent: a case study on E. coli as a model for Gram-negative bacteria. J Colloid Interface Sci 275:177–182.

[5] Yeo SY, Lee HJ, Jeong SH. 2003. Preparation of nano composite fibers for permanent antibacterial effect. J Mat Sci 38:2143–2147.