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Synthesis and characterization of various Nano-silver associated Complexes using Gamma-radiolysis technique for Bio-application

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1. Introduction

As a part of a department of development of various typed organic-inorganic nano-complex using gamma-irradiation for nano-leveled pesticide delivery system (PDS), we are investigating for advanced various types of customized nanomaterials development in bio-industry fields. Specially, we described herein, preparation of various types of nano-Ag associated complexes and results are presented.

2. Methods and Results

In this section, various types of nano-Ag associated complexes were prepared by radiolysis technique and the results are described shortly.

2.1 Various types of nano-Ag associated complexes

Figure 1 shows the reaction mechanism for the formation of NSSPAI, NSS, and NAg via γ-irradiation. The complexes represent a structure in which as follows: NSSPAI formed from an Ag ion, aniline monomer, and Na_2SiO_3 is simultaneously polymerized and subjected to a reduction procedure for the nano-Ag particles within network of polyaniline (PANI) and silica (SiO_2) molecules. NSS formed from an Ag ion, (polyvinylpyrrolidone) PVP, and Na_2SiO_3 is polymerized and subjected to a reduction procedure for the dispersed nano-Ag particles within the PVP and SiO_2. NAg shows a comprised of an Ag ion and PVP.

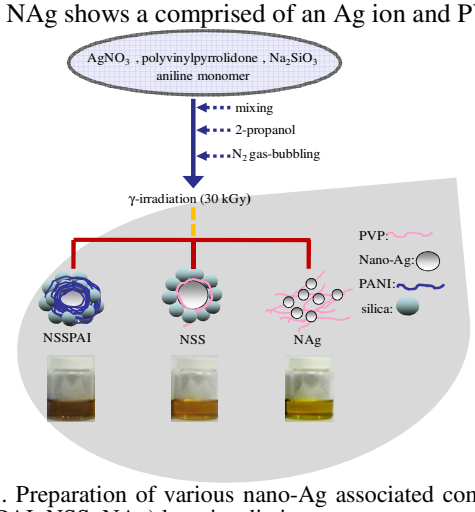

Fig. 1. Preparation of various nano-Ag associated complexes (NSSPAI, NSS, NAg) by γ-irradiation

2.2 Morphology property of nano-Ag associated complexes

The SEM images and EDX analysis showed that nano-Ag associated complexes have a various particles sized ranging from 10 to 40 nm degree of as NAg> NSSPAI>NSS in Fig. 2. NSS and NSSPAI showed a uniformly spherical morphology and size, while NAg was not shown. Surface morphology of nano-Ag complexes was also imaged by TEM, as shown in Fig. 4.

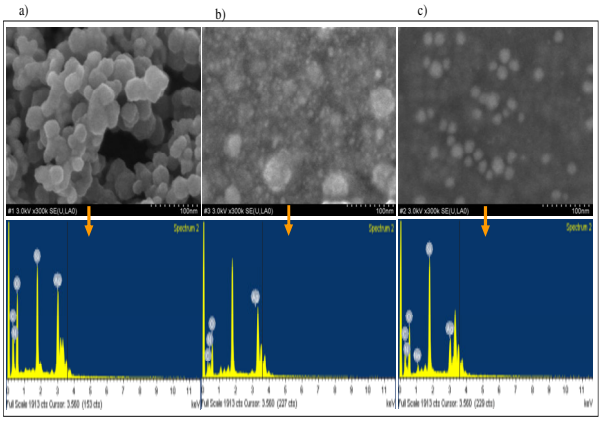

Fig. 2. FE-SEM images and EDX data of nano-Ag associated complexes; NSSPAI (a), NSS (b), NAg (c).

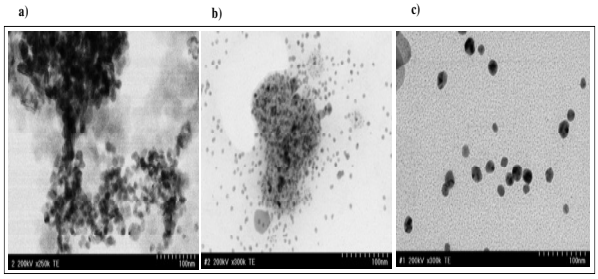

Fig. 3. TEM analysis of NSSPAI (a), NSS (b), and NAg (c).

2.3 Surface property of nano-Ag associated complexes

The crystallinity and surface hydrophobicity of nano-Ag associated complexes indicated that the NSSPAI was strong than the NSS and NAg, relatively, from the XRD and CA analyses in Fig. 4 and Fig. 5.

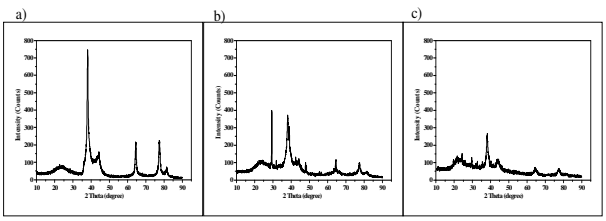

Fig.4. XRD analysis of NSSPAI (a), NSS (b), and NAg (c).

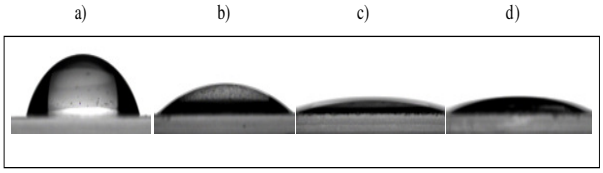

Fig. 5. CA value of Cleaned ITO (a; 69.1°), NSSPAI (b; 22.9°), NSS (c;12.2°), and NAg (d; 11.1°).

2.4 Structural property of nano-Ag associated complexes

XPS analysis indicated very specific and interesting structural bonding formation between each component containing Ag, PVP, SiO_2, and PANI. Also, the results indicate clearly a nano-Ag associated complexes structure in the TEM analysis in Fig. 6.

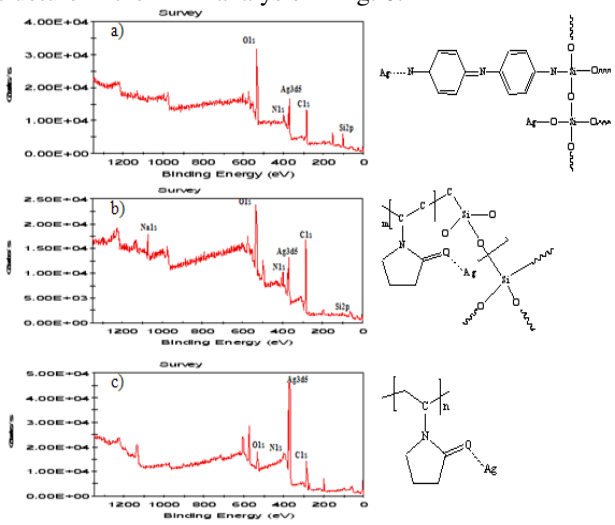

Fig. 6. XPS surveys and structural property of NSSPAI (a), NSS (b), and NAg (c).

3. Conclusions

A various types of nano-Ag associated complexes were prepared and conveniently manufactured by γ-irradiation at room temperature from mixtures of Ag ion, PVP, Na_2SiO_3, and aniline monomer, simultaneously. The different structural property of prepared nano-Ag complexes may show a specific function in various bio-industry fields. Subsequently, we investigated their characterization. From the results, the following conclusions were made:

1. NSSPAI has a complex comprised of nano-Ag particles that are combined with a network of PANI and SiO_2 molecules. In particular, the structure of NSSPAI may play an important role in sensing by using an electrical signal response in the biophysiological system.
2. NSS shown the surface of the nano-Ag (core-part) was coated with either the PVP or SiO_2 molecules (outer part) in an orderly way. From the significant structure interaction observed between the nano-Ag, SiO_2, and PVP, NSS have superior stability and specific high antimicrobial activity under various water conditions, as well as a long preservation period. Consequently, NSS can be able to various environment-friendly nanopesticide systems.
3. NAg from the nano-Ag distributed within PVP may use grafting, coating or fabrication variously for new functional materials.

Therefore, nano-Ag associated complexes can be applicable to needed for customized products including antimicrobial coating material, specific antimicrobial agent, agricultural pesticide or its additives, bio-sensing materials, etc.

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