UNIVERSITI TEKNOLOGI MARA

SYNTHESIS AND CHARACTERIZATION OF SILVER/BENTONITE/STARCH BIONANOCOMPOSITE BY GREEN METHOD

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ABSTRACT

The main focus of this research project is to prepare silver nanoparticles (AgNPs) by using green reduction method in which the silver nitrate ($AgNO_3$) will embed on the surface of bentonite, kaolinite and starch bionanocomposite. Fundamentally, bentonite and kaolinite, starch, D(+)-glucose and silver nitrate were utilized as solid support, stabilizer, green reducing agent and silver precursor respectively. Constant room temperature has been applied towards bionanocomposite. One of important parameter that will be highlighted is including the concentration of silver nitrate which are 10 mM, 50 mM, 100 mM, 150 mM of silver nitrate. Theoretically, concentration of silver nitrate will have impact on the size, shape and morphology of nanoparticles formed. However, it was found that silver/kaolinite/starch bionanocomposite does not produce spectrum at 400 nm of UV-Vis which indicates that there were no nanoparticles being synthesized when using kaolinite as a solid support. Further investigation using other type of clay which is bentonite has been done. It was found that bentonite is a good solid support as it has the capability to produce spectrum of UV-Vis around 400 nm. Additional investigation of properties of bentonite has been made by varying the range of amount such as 1 g, 2 g, 3 g and 4 g of bentonite clay. This is to find the point of stabilization of bentonite in bionanocomposite. The synthesized bionanocomposite is characterized by using Ultraviolet visible spectroscopy (UV-Vis), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM) which are to study the surface plasmon resonance (SPR), crystalline structure, functional groups available and morphology of silver nanoparticles in bionanocomposite respectively. Based on UV-Vis results, higher concentration of silver nitrate and bentonite produced higher peaks indicating more stable nanoparticles formed. From XRD result, it was found that the silver has facets of face centered cubic crystal structure. As for FTIR, the functional groups found were OH-stretch, C-H stretch, C=O group, Si-O stretch, (Al-Mg)-OH vibration which were originated from the samples. According to SEM result, the shape of silver is irregular but strongly bonded to surface of bentonite.

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The greatest blessing is to appreciate every knowledge with full sincerity. That every creation has it purpose and is not futile. Therefore, this research is about seeking and perceive the best from His majestic creation.

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INTRODUCTION

1.1 Research Background

Nanotechnology has been extensively studied and widely used ever since the era of Mesopotamian in which the artisans have been utilizing gold and silver nanoparticles as a glittering effect of utensils and pots. The first researcher who point out scientific explanation of nanoparticles properties is Michael Faraday in his paper called "Experimental Relations of Gold and Other Metals to Light" back in 1857. (Faraday, 1857). Nanoparticles is defined as materials with nano dimension of 1 to 100 nm and have unique properties apart from bulky system. They are extremely small in size and have very large surface area. Out of numerous metal nanoparticles that has been studied, silver nanoparticles have attracted the most attention due to inexpensive compared to gold, have antimicrobial effect, unique optical and electronic properties. Subsequently, silver nanoparticles have been commercially available as a drug delivery, water treatment, agricultural and also in biomedical field.

There are plenty methods that can be implemented to synthesize nanoparticles such as physical, chemical, green or biological method. As for physical method, it includes irradiation beam, mechanical grinding, milling and spray pyrolysis whereas chemical method includes coprecipitation, micro emulsion and chemical reduction using organic solvents. Both conventional processes can result in production of toxic byproduct, complicated process, costly, inefficient and unsuitable to be used in clinical field. In contrary, green or biological method is environmental friendly due to usage of nontoxic chemicals, less energy and utilize renewable materials. Besides that, the green method also very known as cost-effective, simple and compatible for application in health and pharmaceutical field. (Shameli et al., 2012). Some examples of green method including D-glucose (Ortega-Arroyo et al., 2013), microorganism, fungi, algae, plant extract and enzymes. (Patra & Baek, 2014). For this particular research, β-D-glucose will be used as a green reducing agent of silver nanoparticles. According to Narayanan and Sakthivel, green method is a very significant and suitable alternative route of biocompatibility in synthesis of stable nanoparticles. (Narayanan and Sakthivel, 2011).