# Clay-AgNP Nanohybrids Exhibiting news Temperature-Responsive and Antimicrobial Potency

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## Abstract

Clay-AgNP Nanohybrids were synthesized by in situ reduction of silver nitrate in the presence of nanosilicate platelet (NSP) tethered with poly(*N*-isopropylacrylamide) (PNiPAAm). The TEM photographs were shown AgNP attachment on the NSP surface via a strong ionic interaction and enhanced the dispersion ability in water by grafting PNiPAAm to NSP. The inorganic clay with multilayer structure and exchangeable $Na^+$ counter ions on surfaces provided a large surface area for immobilize AgNP in the range of 10–15 nm in diameter. Furthermore, the lower critical solution temperature (LCST) of nanohybrids were maintained at 32 °C and indicated there is no interaction between AgNP and PNiPAAm. With the optimun composition of AgNP/NSP-PNiPAAm , the material exhibits a high potency against bacterial growth.

**Keywords:** NSP-PNiPAAm, AgNP, antibacterial

## Introduction

Over the past decade, PNiPAAm has received a great deal of attention as a thermoresponsive polymer. The polymer exhibits LCST behavior at 32 °C and undergoes a coil-to-globule phase transition induced by expulsion of water from the chain. In our previous studies, we used a living polymerization technique to graft moieties to the NSP edge surface through covalent bonding to produce polymer. We also have investigated the role of layered silicate clays as support for surface interactions with Ag ions and $Ag^0$ nanoparticle after the reduction. In this report, we investigate the generated AgNP/NSP-PNiPAAm complexes were characterized for their physical properties, morphology, and antibacterial effect.

For the attachment of AgNP, the method of *in situ* reduction of silver nitrate in the presence of NSP-PNiPAAm was developed (Figure 1).

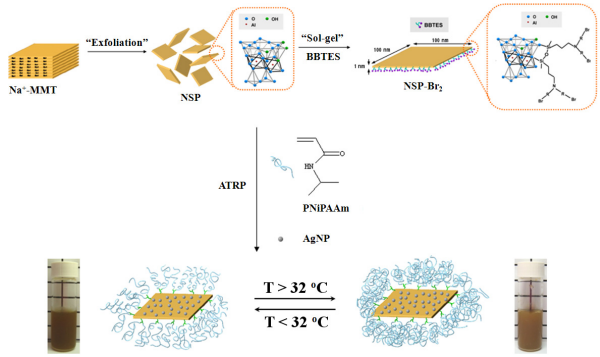


Fig.1. AgNP dispersion in NSP-PNiPAAm solution.

In order to understand the formation of AgNP and their interaction with NSP surface or PNiPAAm of polymer chain. The TEM photograph was shown the clear picture of AgNP distribution on the NSP surface, indicating a strong ionic interaction (Figure 2). The inorganic clay with multilayer structure and exchangeable $Na^+$ counter ions on surfaces provided a large surface area for immobilize AgNP in the range of 10–15 nm in diameter. Besides, the LCST of nanohybrids were maintained at 32 °C and indicated there is no interaction between AgNP and PNiPAAm(Figure 3).

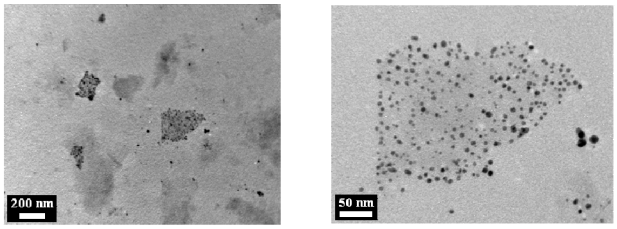


Fig.2. TEM of AgNP attachment on NSP surface.

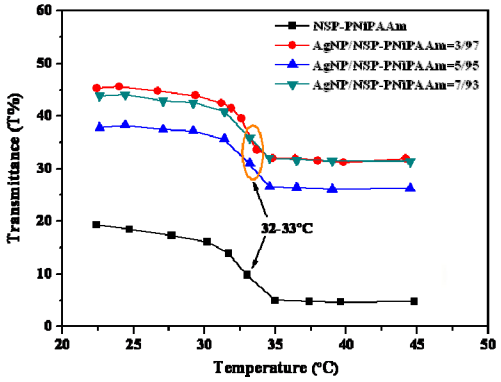


Fig.3. Nanohybrids maintain temperature at 32 °C.

Improvement the solution dispersion ability via grafting PNiPAAm to NSP, it can provide more surface area for bacterial contact and hence are more potent suppressors of cell growth. To delineate the antimicrobial mechanisms of the AgNP/NSP-PNiPAAm, bacteria were grown on the LB agars with the same content of AgNP/NSP-PNiPAAm composition but with different concentration of AgNP from the sample. The loading minimum inhibition concentration of 21 ppm, efficiently restrained bacterial growth (Figure 4).

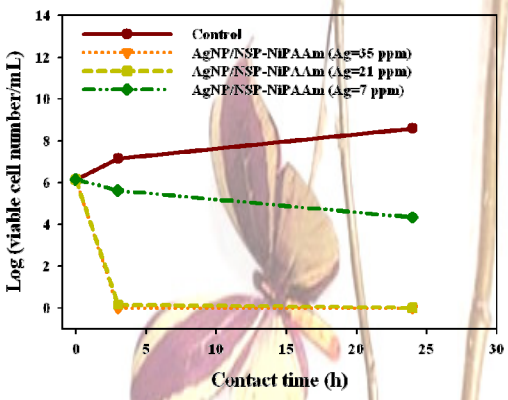


Fig.4. Minimum inhibition concentration (MIC) at 21 ppm.

## Conclusion

The AgNP was synthesized from the reduction of silver nitrate in the presence of inorganic silicate platelet with PNiPAAm. It has been shown AgNP immobile on the NSP surface via a strong ionic interaction by TEM photograph. We observed the LCST remaining at 32 °C, implied that no interaction between AgNP and NSP. By grafting PNiPAAm to NSP enhance solution dispersion ability, it can be provide more surface area for bacterial contact and hence are more potent suppressors of cell growth. With the optimun composition of AgNP/NSP-PNiPAAm at weight ratio of 7/93 , the material exhibits a high potency against bacterial growth at minimum inhibition concentration (MIC) of 21 ppm.

## Acknowledgement

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