

# IN SITU SYNTHESIS OF ACRYLAMIDE HYDROGELS CONTAINING SILVER NANOPARTICLES BY PHOTOINDUCED PROCESSES AND THEIR ANTIBACTERIAL PROPERTIES

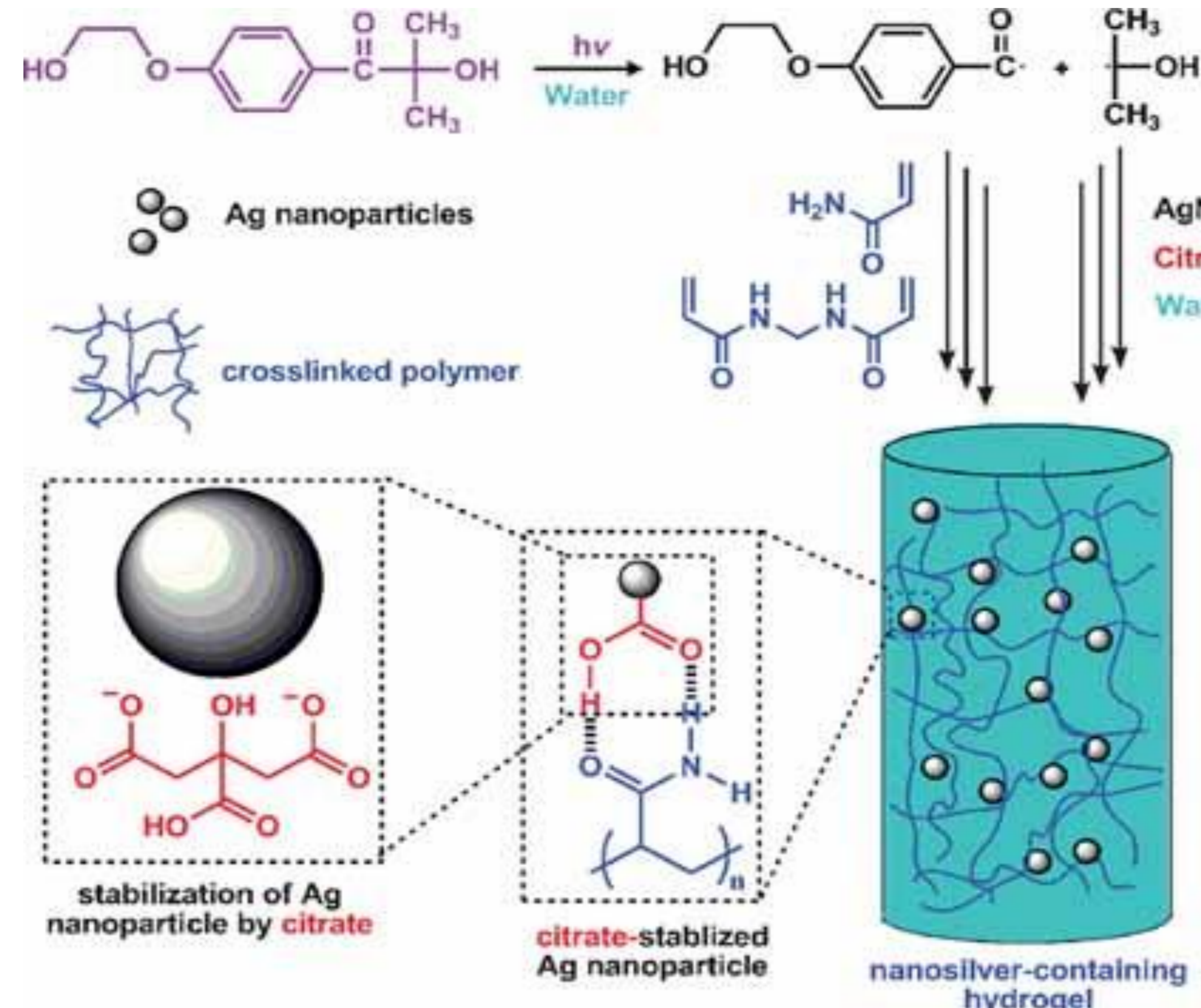
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## MOTIVATION

A two-component photochemical system based on the free radical polymerization and redox processes has been designed for the in situ preparation of hydrogels with Ag NPs. UV light is used to excite the photoinitiator which then undergoes homolytic scission to generate two radicals. While either or both radicals initiate the cross-linking copolymerization of AAm and BAAM, the electron



transfer reaction between the electron donor radical and silver nitrate, results in the formation of Ag NPs. In this communication, the various experimental and compositional parameters that affect the hydrogel behavior, were investigated, and swelling and deswelling properties were evaluated. The hydrogels containing well-dispersed Ag NPs showed significant antibacterial activity.

Synthesis of AAm/BAAM hydrogel containing Ag NPs by photoinduced free radical aqueous polymerization and reduction of silver cations simultaneously.

## RESULTS & DISCUSSIONS

| Gel   | AgNO <sub>3</sub><br>wt.-% | Irgacure 2959<br>wt.-% | Citrate<br>wt.-% |
|-------|----------------------------|------------------------|------------------|
| Gel-1 | 0.12                       | 0.032                  | 0.182            |
| Gel-2 | 0.12                       | 0.047                  | 0.182            |
| Gel-3 | 0.12                       | 0.063                  | 0.182            |
| Gel-4 | 0.24                       | 0.063                  | 0.364            |
| Gel-5 | 0.36                       | 0.063                  | 0.546            |

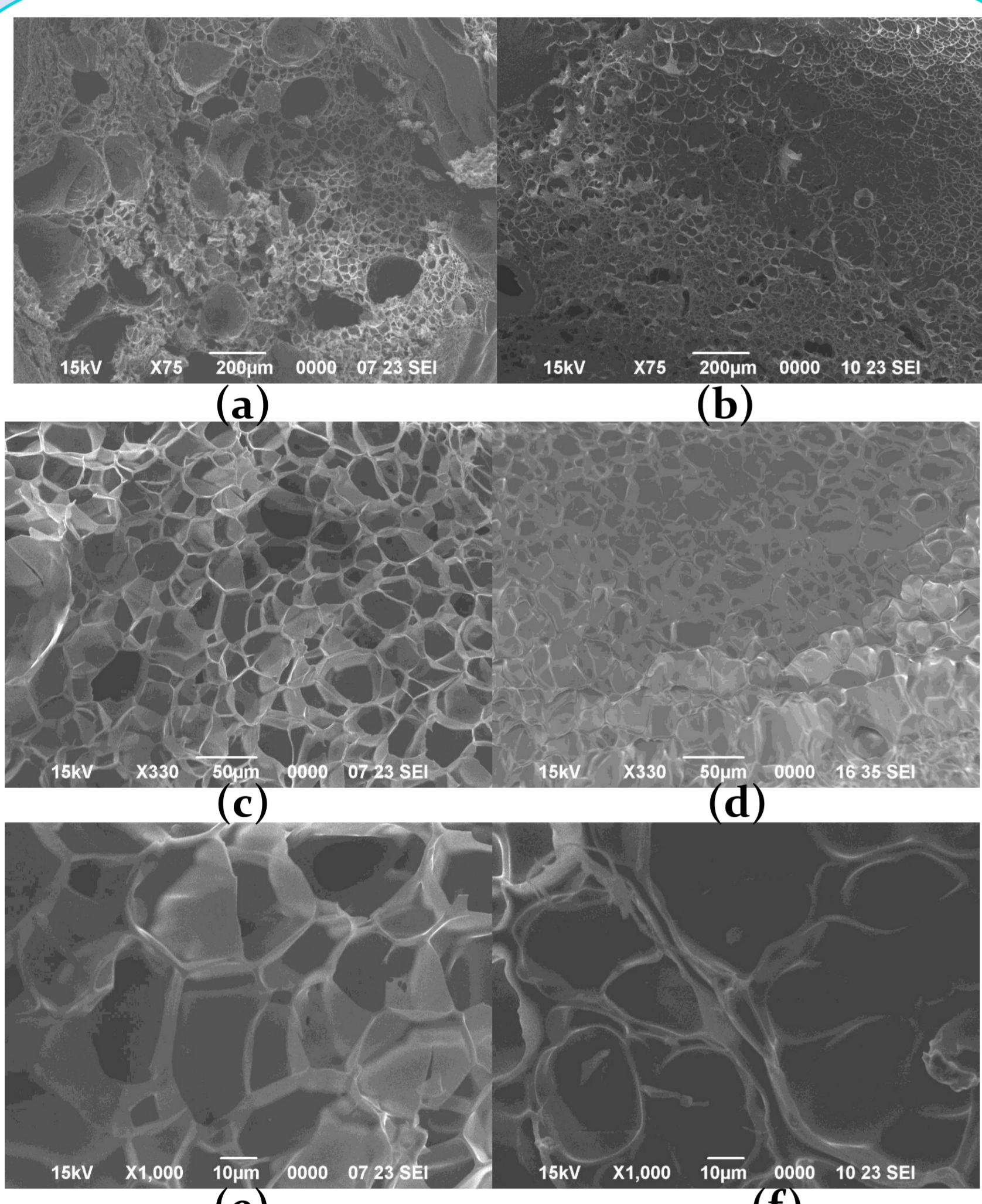
AAm/BAAM (9.876 and 0.124 wt.-%, respectively) and reduction of AgNO<sub>3</sub> induced by Irgacure 2959b.

| Gel    | AgNO <sub>3</sub><br>wt.-% | Citric acid<br>wt.-% | Citrate<br>wt.-% | pH of solution |
|--------|----------------------------|----------------------|------------------|----------------|
| Gel-6  | 0.12                       | 0.135                | 0                | 2.9            |
| Gel-7  | 0.12                       | 0.101                | 0.045            | 3.5            |
| Gel-8  | 0.12                       | 0.068                | 0.091            | 4.5            |
| Gel-9  | 0.12                       | 0.034                | 0.136            | 5.5            |
| Gel-1  | 0.12                       | 0                    | 0.182            | 7.1            |
| Gel-10 | 0                          | 0                    | 0                | 6.2            |

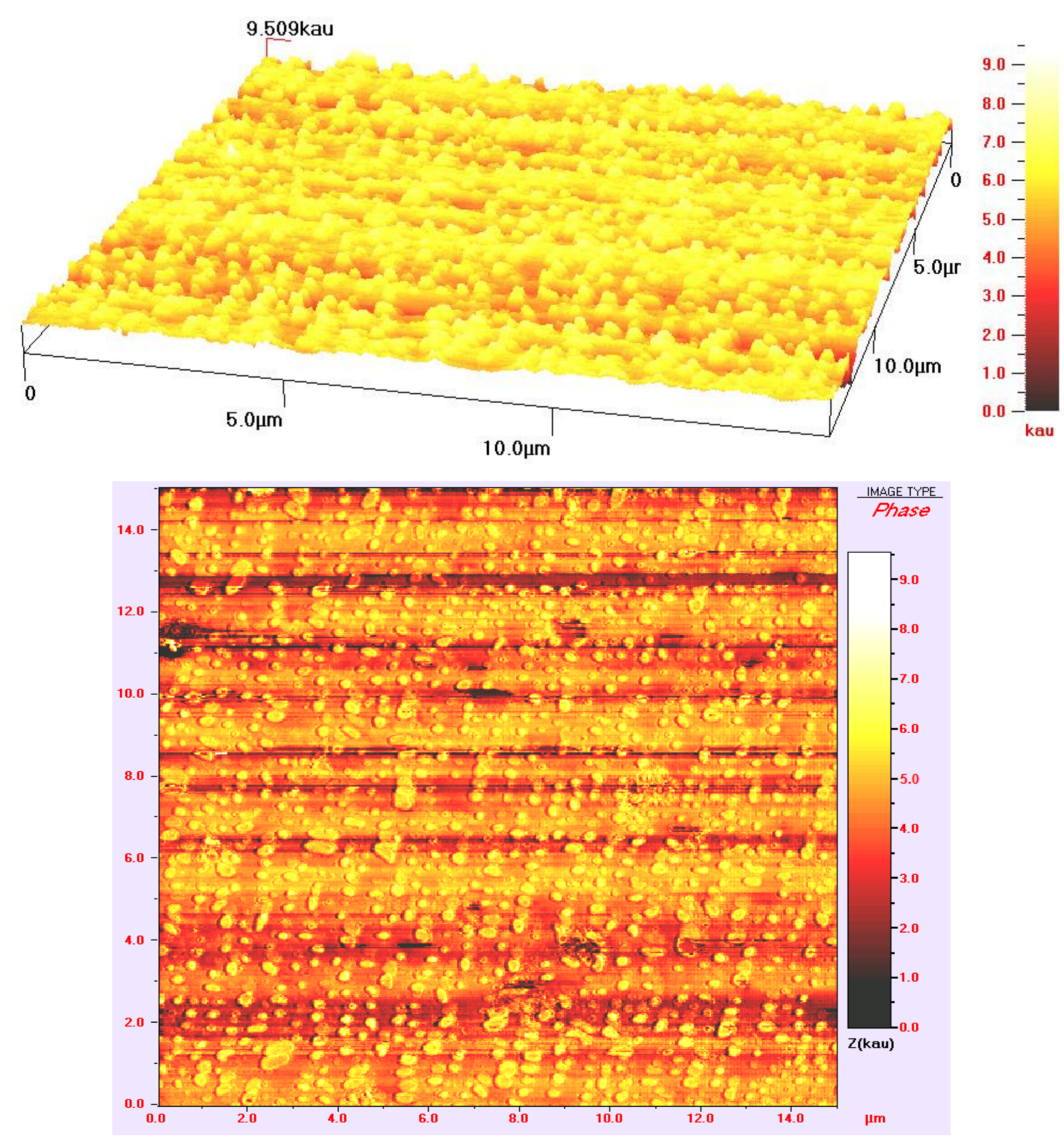
Formulations for free radical photopolymerization of AAm/BAAM (9.876 and 0.124 wt.-%, respectively) and reduction of AgNO<sub>3</sub> induced by Irgacure 2959b (0.032 wt.-%) at different pH values.



Photographs of the freeze-dried hydrogels with (Gel-9) or without (Gel-10) Ag NPs.



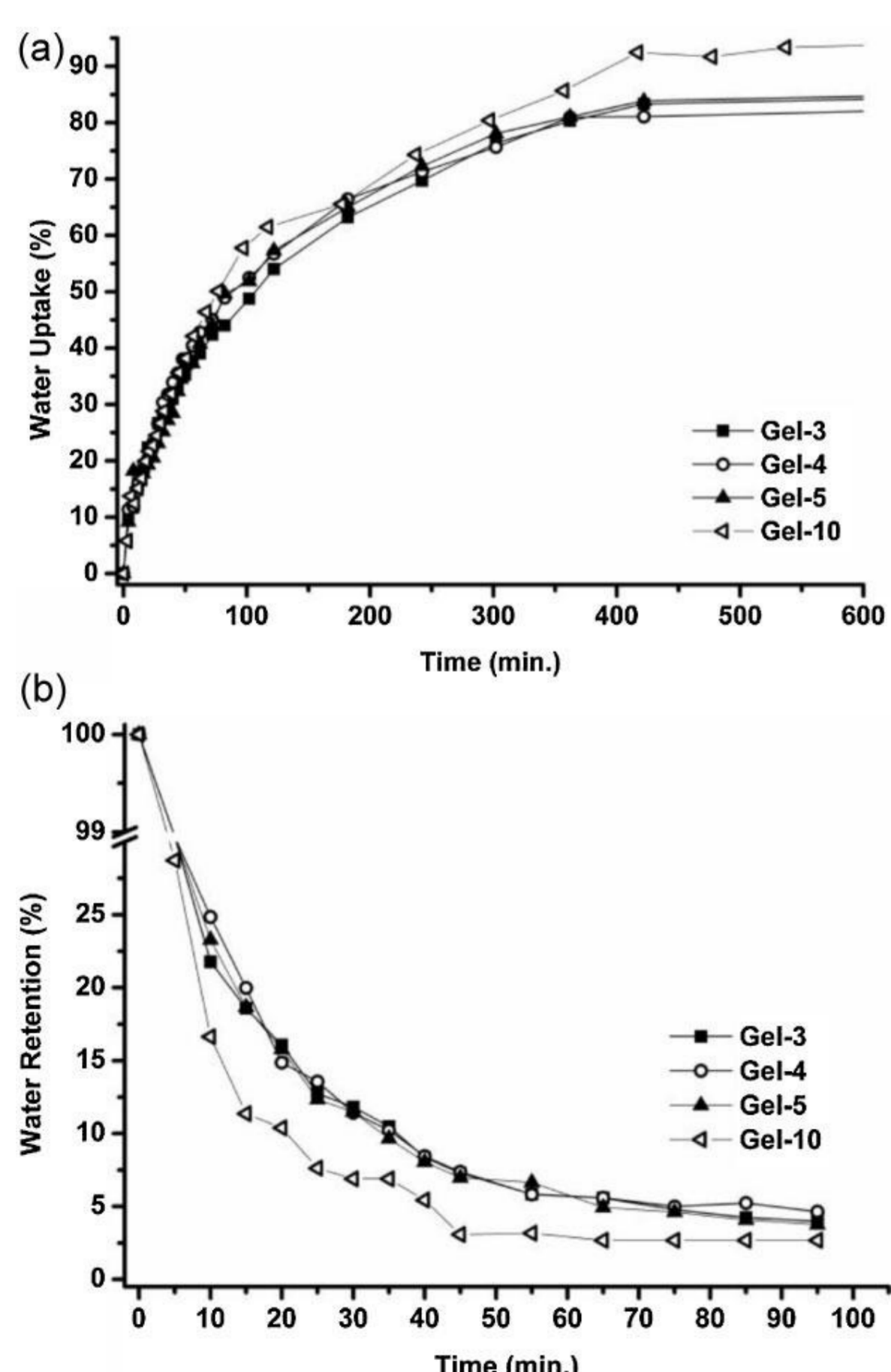
SEM micrographs of hydrogels with [Gel-5 (a, c, and e)] or without [Gel-10 (b, d, and e)] Ag NPs.



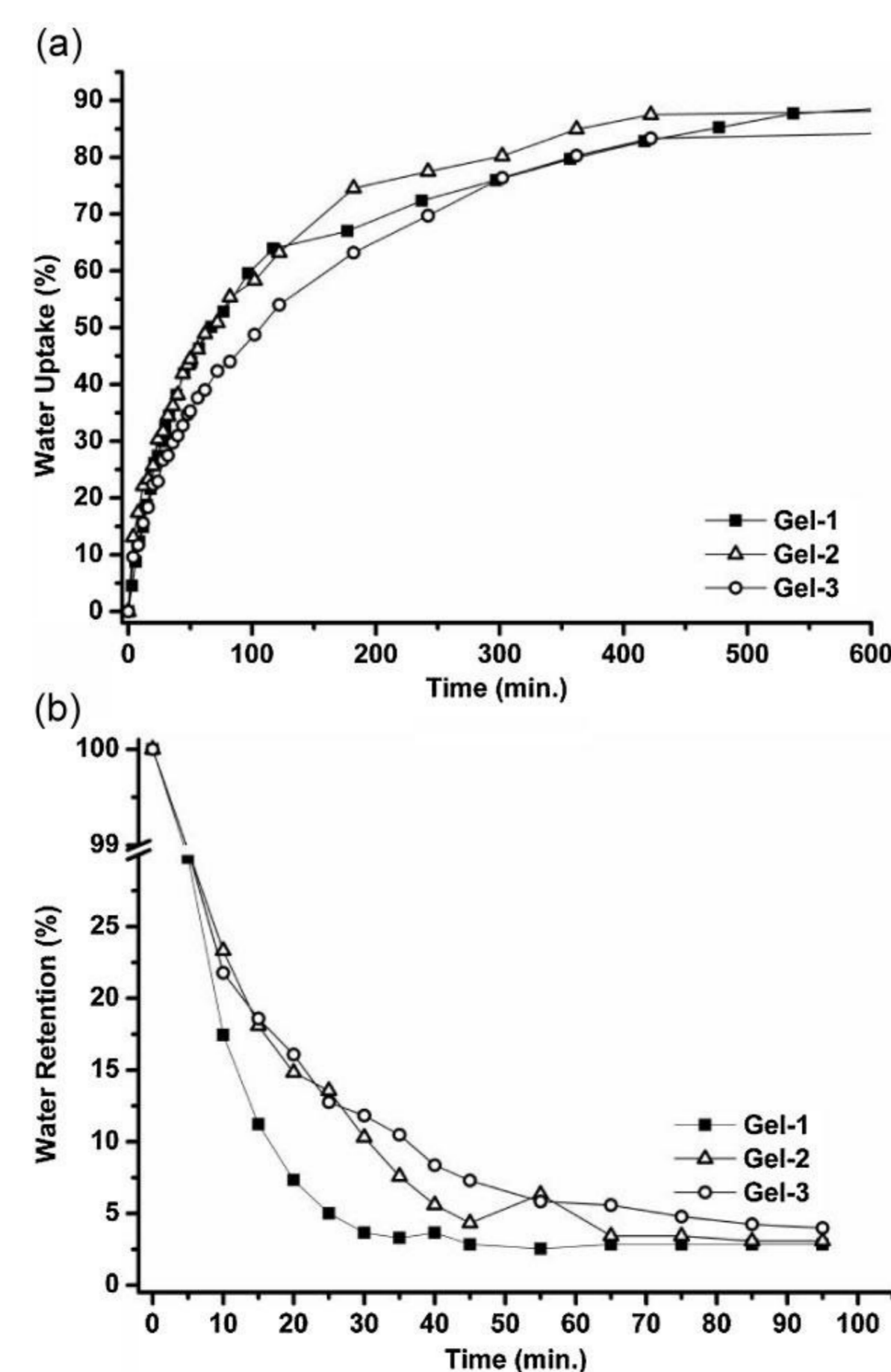
AFM micrographs of Ag NPs obtained from the solution in which hydrogel containing Ag NPs (Gel-5) was stored.

|                                   | Microorganism                                     |  |  |
|-----------------------------------|---|--|--|
|                                   | <i>E. coli</i> O157:H7, pathogenic, Gram-negative | <i>E. coli</i> K-12, non-pathogenic, Gram-negative | <i>S. aureus</i> pathogenic, Gram-positive |
| Hydrogel with Ag NPs <sup>a</sup> |   |  |  |
| Zone Diameter                     | (19 mm)   | (19 mm)  | (14 mm)                                    |
| Pure hydrogel                     |   |  |  |
| Zone Diameter                     | (-)   | (-)  | (-)  |

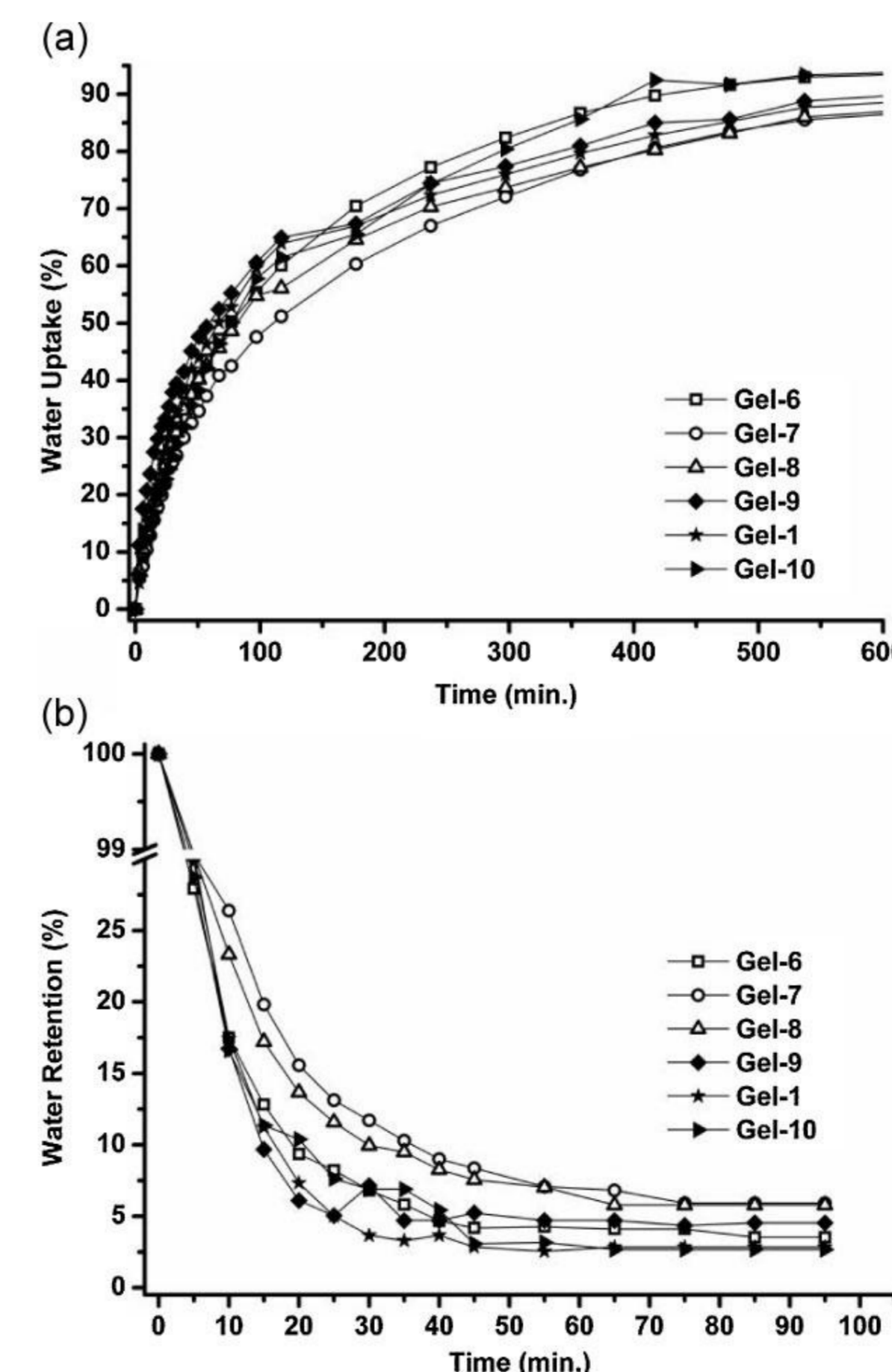
Anti-bacterial activity of the hydrogels with (a) or without (b) Ag NPs against pathogenic *E. coli* O157:H7, *S. aureus*, and non-pathogenic *E. coli* K-12 (Cell density: 10<sup>5</sup> CFU mL<sup>-1</sup>).



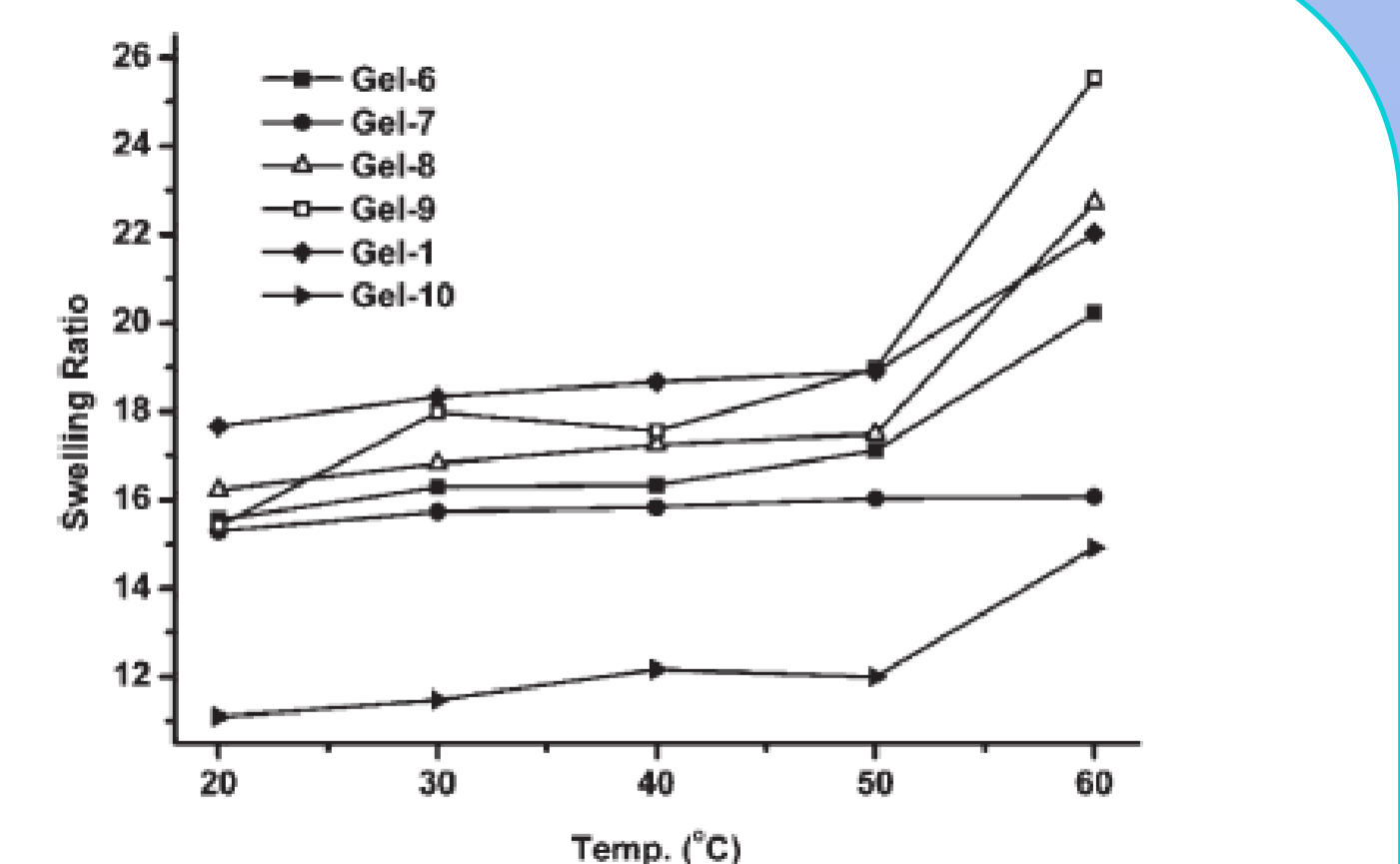
Effect of the initial silver nitrate concentration on swelling (a) and deswelling (b) kinetics of the hydrogels.



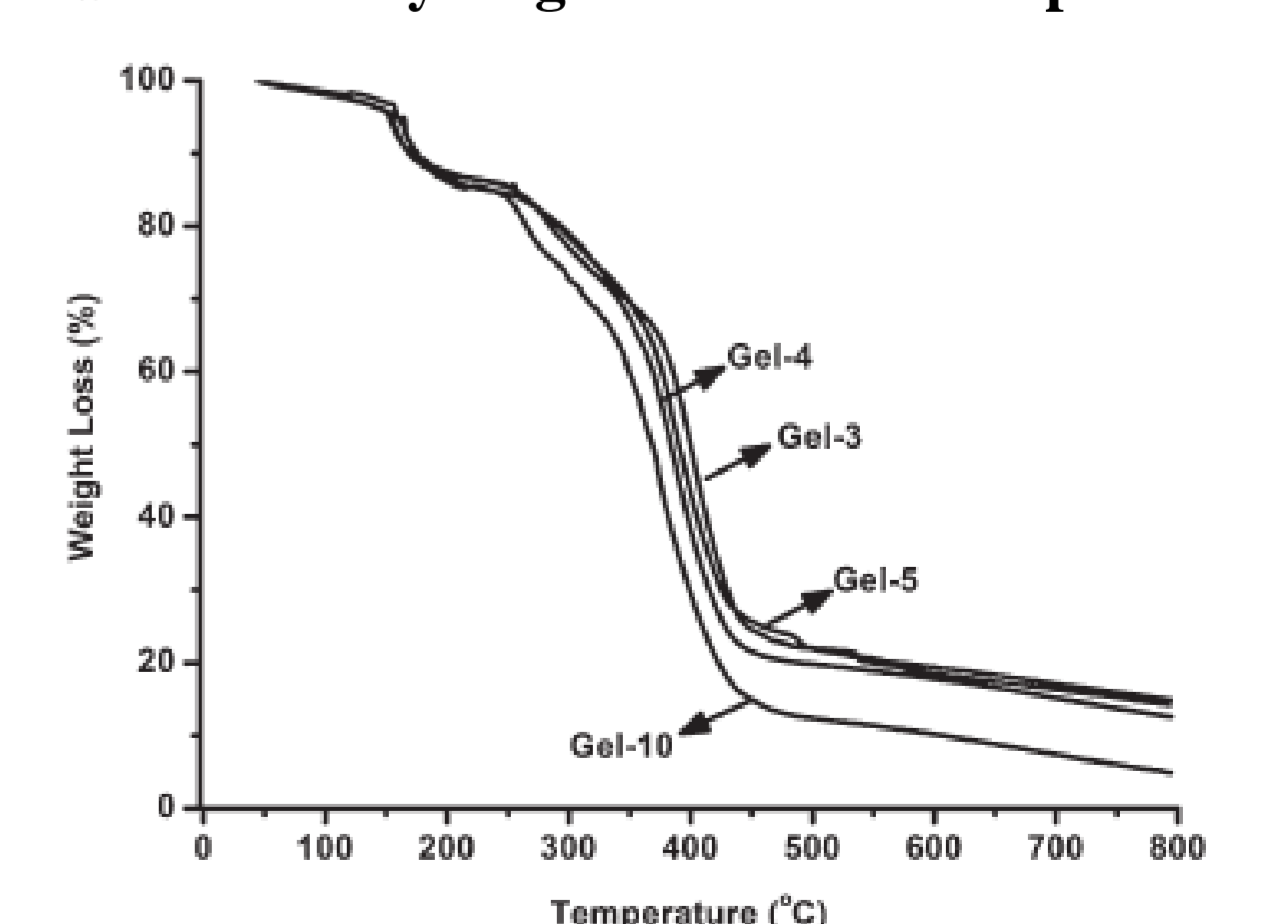
Effect of the initial photoinitiator concentration on swelling (a) and deswelling (b) kinetics of the hydrogels.



Effect of pH of the formulations on swelling (a) and deswelling (b) kinetics of the hydrogels.



SRs of the hydrogels at various temperatures.



Effect of the amount of Ag NPs on thermal stabilities of the hydrogels. Gels contain 0.12 (Gel-4), 0.24 (Gel-5), and 0.36 (Gel-10) wt.-% Ag NPs. Gel-10 does not contain Ag NPs.

## Acknowledgement

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## References

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