Two-step preparation of silver nanoparticles

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Abstract

The silver colloidal dispersions were obtained by two-step preparation method. The first step was based on preparation of the colloidal dispersions of silver bromide nanoparticles (NPs), which were reduced by sodium borohydride in the second step. The effective diameters of silver bromide nanoparticles and silver nanoparticles were determined by using of dynamic light scattering (DLS) and transmission electron microscopy (TEM) techniques. The colloidal dispersions of silver bromide nanoparticles were prepared by the reaction of silver nitrate and potassium bromide solutions mixed in various ratios. The influence of $KBr/AgNO_3$ ratio to particle size was verified by using of two preparation ways. The first preparation way was based on using of the various concentration of potassium bromide and constant concentration of silver nitrate in the reaction systems. In the second case, the various concentration of silver nitrate and constant concentration of potassium bromide in the reaction systems were used. The $KBr/AgNO_3$ ratios were 2, 5, 10, 20 and 50 in the both cases to easy comparison of obtained results. Synthesized silver bromide nanoparticles were reduced by sodium borohydride to silver nanoparticles with size between 29 and 50 nm.

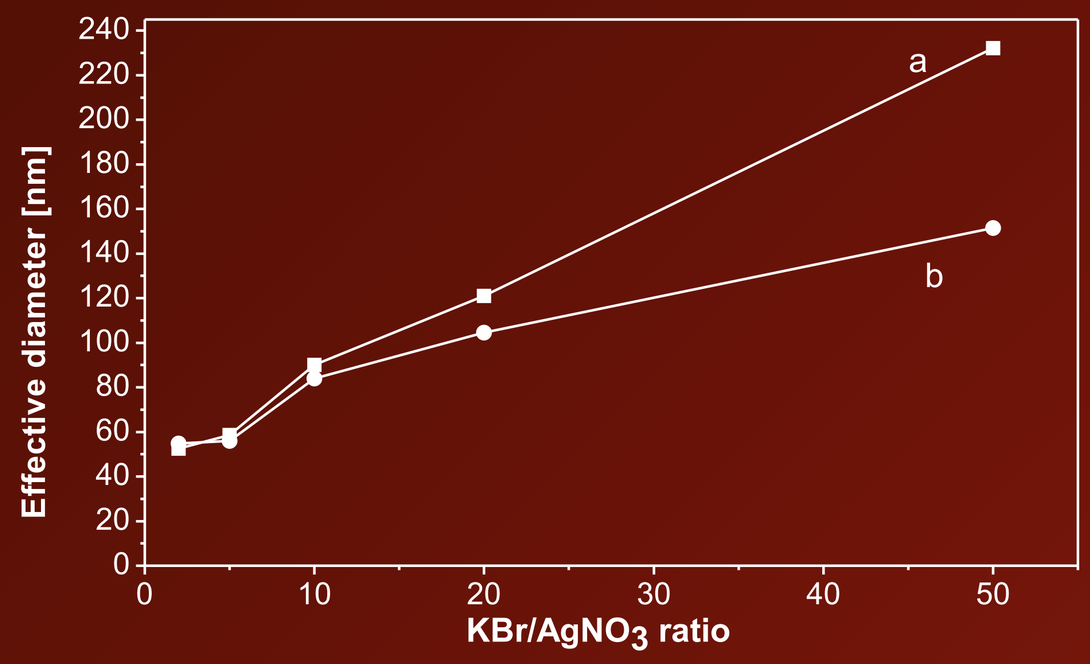

Figure 1: The influence of $KBr/AgNO_3$ ratio on the particle size of AgBr particles prepared in the presence of a) constant concentration of $AgNO_3$ and various concentration of KBr, b) constant concentration of KBr and various concentration of $AgNO_3$.

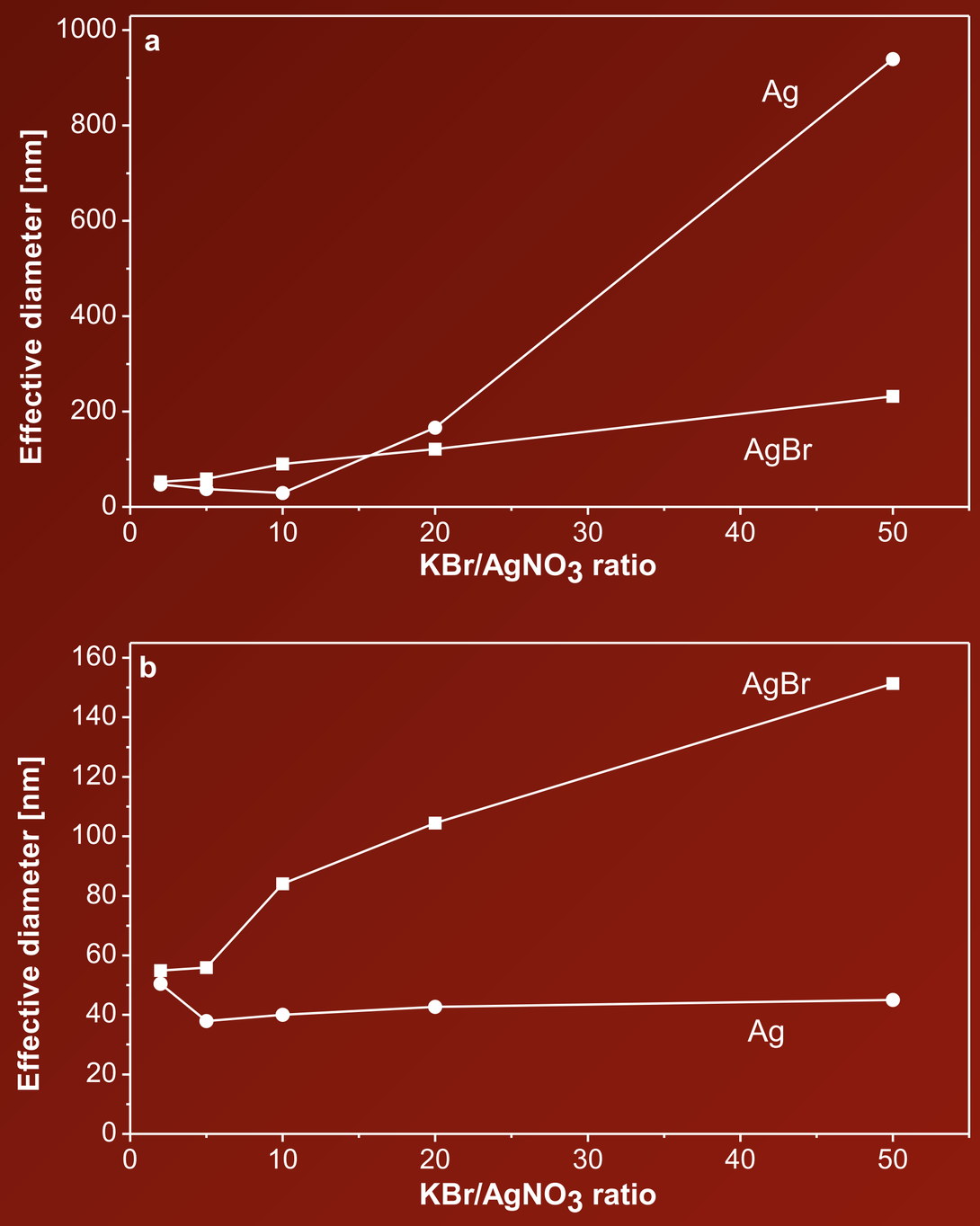

Figure 2: The effective diameter of Ag nanoparticles obtained by reduction of AgBr nanoparticles prepared in the presence of: a) constant concentration of $AgNO_3$ and various concentration of Kbr, b) constant concentration of KBr and various concentration of $AgNO_3$.

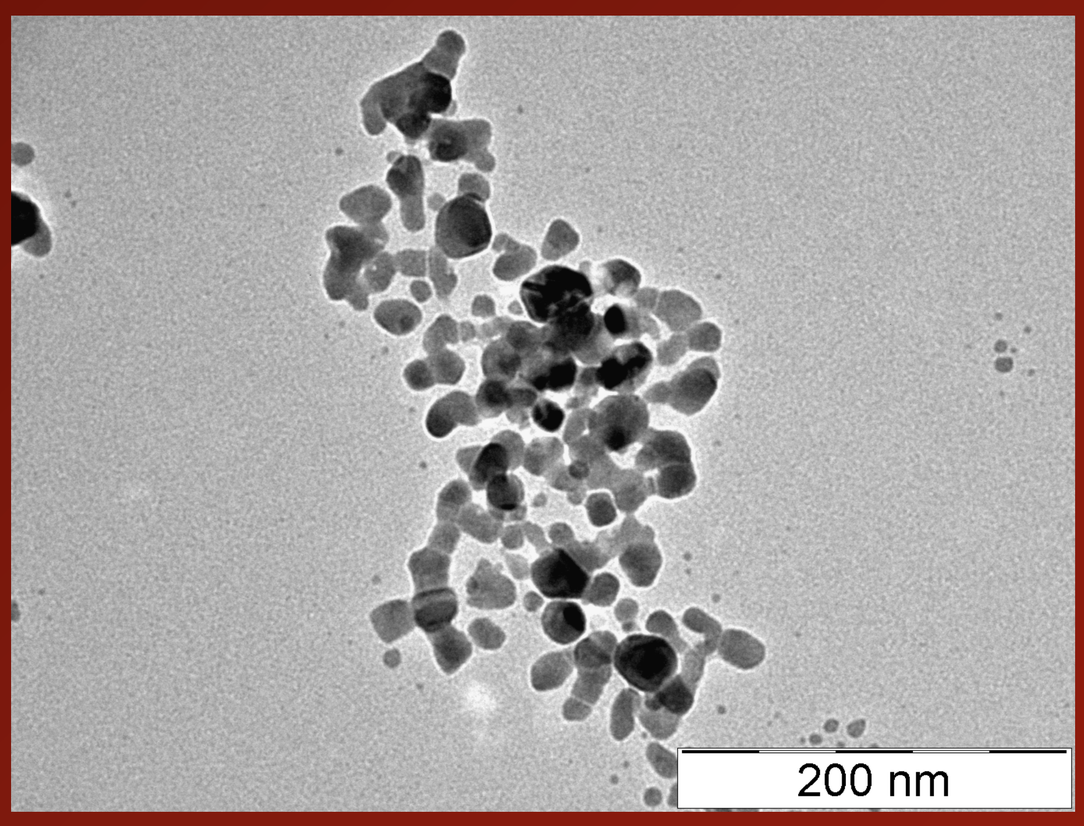

Figure 3: TEM image of Ag nanoparticles obtained by reduction of AgBr particles prepared in the presence of $1 \cdot 10^{-3}$ M $AgNO_3$ and $1 \cdot 10^{-2}$ M KBr.

Conclusions

The realized study demonstrates facile preparation of silver bromide particles with various effective diameters, which can be effectively transformed into silver nanoparticles. The performed experiments shows, the size of prepared silver bromide nanoparticles highly depends on a reaction compounds ratio and furthermore on concentration of potassium bromide in the reaction system. The particle size of prepared AgBr increases with increasing ratio of $KBr/AgNO_3$. Following reduction of prepared silver bromide particles enables preparation of silver nanoparticles with effective diameter around 40 nm. The obtained experimental data shows, that stability of prepared silver nanoparticles depend on concentration of Br- ions in reaction system. In the excess of Br- ions, nanoparticles quickly aggregate.

Acknowledgements

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