# Is it possible to reuse CTAB growth solution of gold nanorods?

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## Introduction

Gold nanorods are widely used for diagnostics and therapy of cancer and in such scientific disciplines as genomics, biosensorics, etc. The main method of preparation of gold nanorods is their growth in a cetyltrimethylammonium bromide (CTAB) solution. The CTAB solutions are a toxic surfactant and harm environment to fall into the world ocean. Thus, reuse of CTAB solution is an urgent task. The arm of work is test of possibility to reuse cleansed growth CTAB solutions (CGCS) for multiple syntheses of gold nanorods.

## Materials and methods

The initial synthesis carried out according the protocol in work [1]. Each re-synthesis was performed from a CGCS according to the protocol of the initial synthesis without using of hydrochloric acid. After each synthesis the growth solution was purified from gold nanoparticles by four times centrifugation, where each time the rcf was 15kg for 1.5 hours. In the work two series of experiments were performed: (1) - multiple reusing of CGCS, (2) – management of the geometric size of gold nanoparticles by varying the concentration of silver nitrate added to a CGCS.

## Results

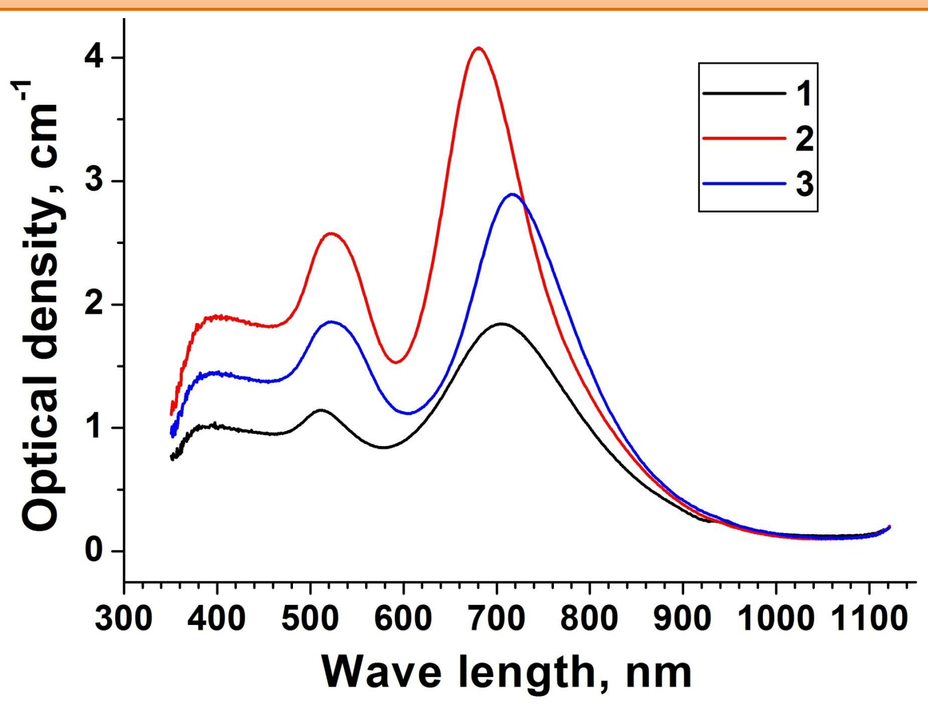


Fig.1. Absorb spectra of growth solution after synthesis

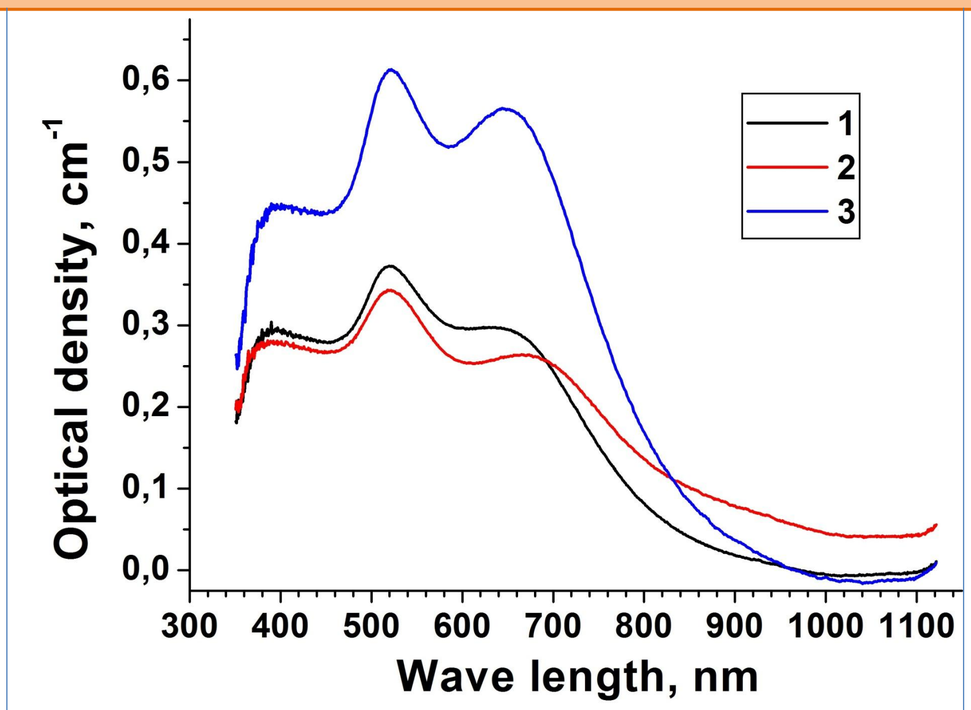


Fig.2. Absorb spectra of cleansed growth solution

(1) – initial syntheses
(2) – the first re-syntheses without silver nitrate
(3) – the first re-syntheses with silver nitrate

The results of initial synthesis and re-syntheses pictures on fig.1. The increase of optical density at a wavelength of 450 nm is associated with an increase of the gold concentration in the growth solution due to incomplete purification of the growth solution from gold nanorods. The wavelength shift of the absorption maximum is associated with a variation in the CTAB concentration at a constant concentration of silver nitrate. A decrease of the CTAB concentration after the first centrifugation leads to a wavelength shift of the absorption maximum to the violet region, and an increase of the CTAB concentration after the second centrifugation leads to a wavelength shift of the absorption maximum to the red region.

Absorb spectra of cleansed growth solutions after centrifugations are plot on fig.2. Even prolonged centrifugation can't completely purify the growth solution.

The influence of silver nitrate concentration on gold nanorod growth presents on fig.3. As expected, a decrease in the silver concentration leads to a wavelength shift of the absorption maximum to the violet region. This experiment shows the ability to management the spectrum position of the absorb maximum for re-syntheses of gold nanorods from a CGCS.

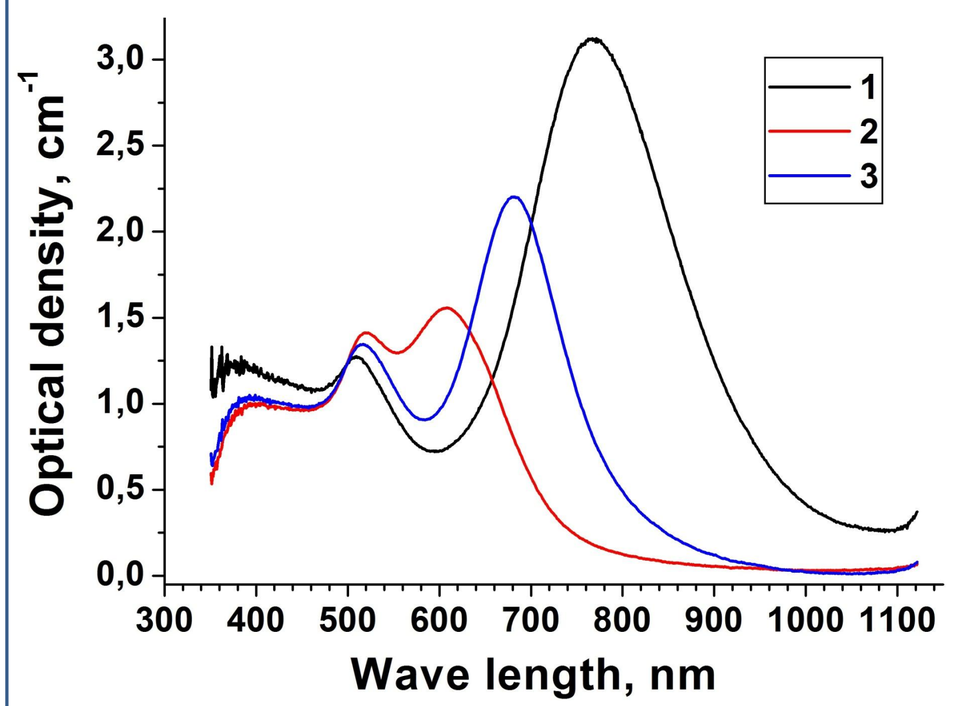


Fig.3. Absorb spectra of growth solution after synthesis: (1) – initial syntheses, (2) – the first re-syntheses without silver nitrate, (3) – the first re-syntheses with silver nitrate

## Discussion and conclusion

1. Even prolonged centrifugation cannot completely purify the growth solution.
2. It is possible to growth gold nanoparticles again in cleansed growth CTAB solutions.
3. The variation of CTAB and silver nitrate concentrations in cleansed growth CTAB solutions is the key to management the spectrum position of the absorb maximum.

## References

[1] Terentyuk G.S., Ivanov A.V., Polyanskaya N.I., Maksimova I.L., Skaptsov A.A., Chumakov D.S., Khlebtsov B.N., Khlebtsov N.G. Photothermal effects induced by laser heating of gold nanorods in suspensions and inoculated tumours during in vivo experiments // **Quantum Electronics**, 2012, V.42., I.5, P.380 – 389

## Acknowledgements

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