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Plasmon-Induced Fluorescence Enhancement of Methylene Blue by Silver Nanoparticles

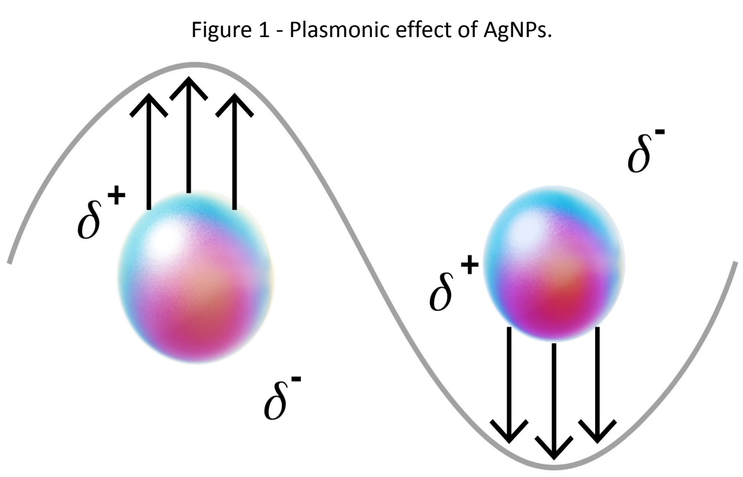
Luís Henrique Raimundo[1], Beate Saegesser Santos[2]

[1]Departamento de Ciência dos Materiais, Universidade Federal de Pernambuco, Recife, 50670-901, Brasil

[2]Departamento de Ciências Farmacêuticas, Universidade Federal de Pernambuco, Recife, 50740-520, Brasil

INTRODUCTION & AIM

Figure 1 - Plasmonic effect of AgNPs.



Source: Author.

Silver nanoparticles (AgNPs) exhibit optical properties associated with surface plasmon resonance, which can enhance the local electric field in the vicinity of molecules such as methylene blue (MB), leading to increased fluorescence intensity.

For this amplification to be effective, two criteria must be fulfilled: (i) spectral overlap between the extinction spectrum of the AgNPs and the absorption spectrum of MB; and (ii) an appropriate distance, estimated to be between 10 and 20 nm, between the nanoparticles and the emitting molecule, enabling electromagnetic coupling without fluorescence quenching.

METHOD

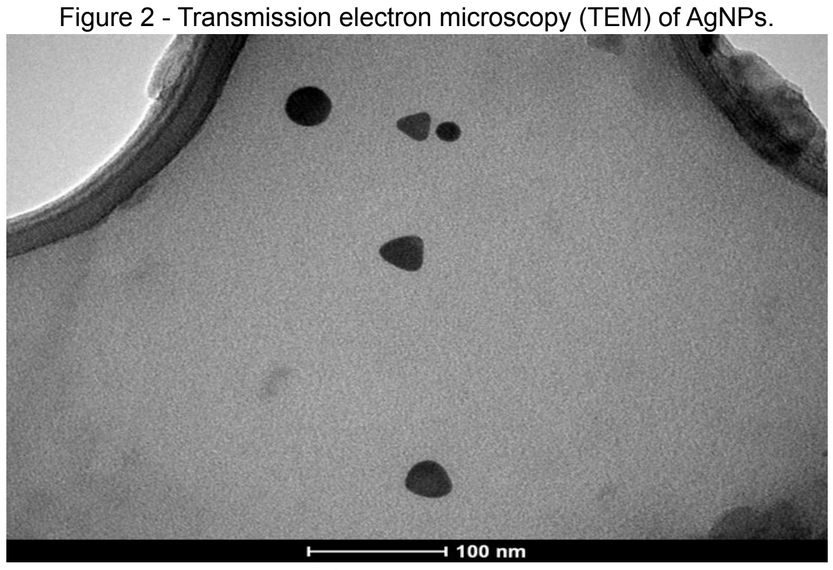
Synthesis of AgNPs: Silver nanoparticles were synthesized in a solution containing 10 mmol sodium citrate, 500 mg L^{-1} poly(sodium 4-styrenesulfonate), ascorbic acid, and 10 mmol sodium borohydride, followed by titration with 0.5 mmol $AgNO_3$ under stirring.

Production of the systems:

Illustration 1 – Production of the systems.

Characterization of the systems: Absorption, emission, and transmission electron spectroscopy.

Figure 2 - Transmission electron microscopy (TEM) of AgNPs.

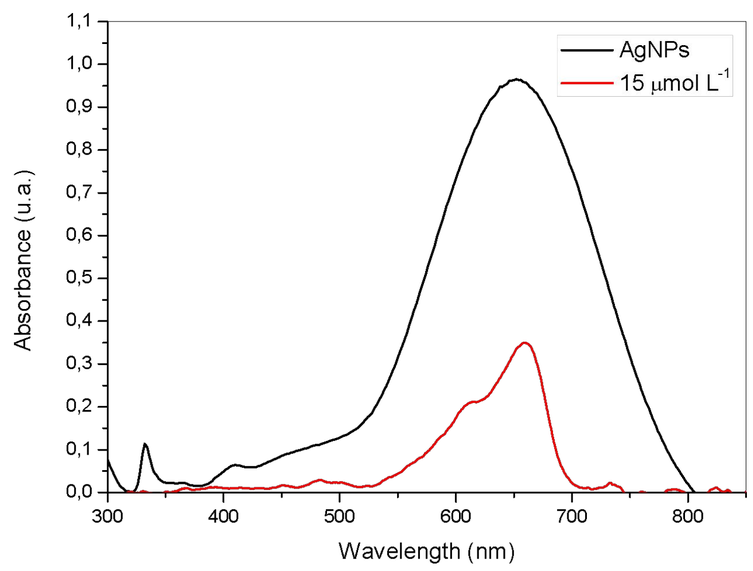


Source: Author.

Most of these AgNPs exhibit widths ranging from 25 to 30 nm, with an average size of 26 ± 7 nm, and their corresponding extinction spectrum is presented in Figure 3.

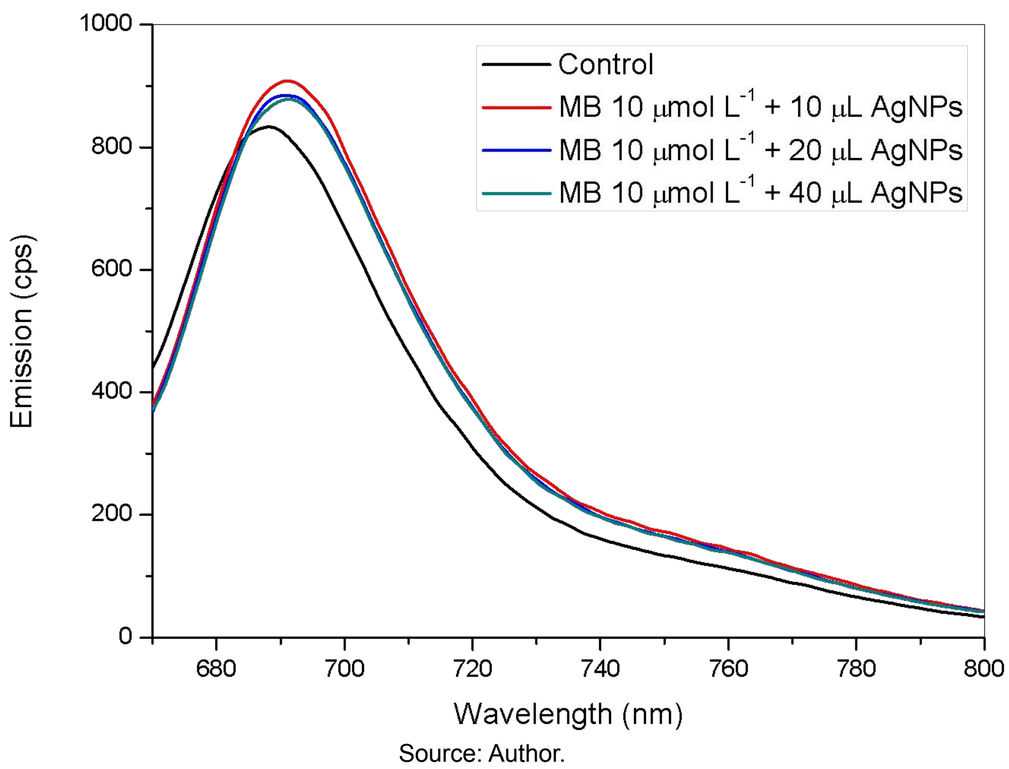
RESULTS & DISCUSSION

Figure 3 - Overlap of the AgNPs extinction spectrum with the absorption spectrum of MB 15 µmol L^{-1}.



Source: Author.

Figure 4 - Emission of the control group and the produced systems.



Source: Author.

The association of MB with AgNPs resulted in changes in fluorescence intensity. An increase of 9.0% was observed with the addition of 10 µL of AgNPs, whereas volumes of 20 and 40 µL led to smaller enhancements of 6.1% and 5.4%, respectively. These findings indicate that increasing the amount of nanoparticles does not necessarily result in greater fluorescence signal amplification.

CONCLUSION

It is concluded that fluorescence enhancement of MB is feasible under the studied conditions, with the addition of 10 µL of AgNPs being the most effective. These results highlight the potential of this system for applications in phototherapy and other photoinduced processes.

FUTURE WORK / REFERENCES

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