JULY 12–16 2020 VIRTUAL
JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

# Evaluation of Biocompatible PEGylated Gold Nanoparticles vs Citrate-Capped Gold Nanoparticles for Targeting Liver and Cervical Cancer Cells in Radiation Therapy

S. David[1], K Mayer[2] , T Gray[3] , A Locker[4] , D Patel[5] , N Kirby[6]

(1) University of Texas at San Antonio, San Antonio, TX, (2) University of Texas at San Antonio, San Antonio, TX, (3) The University of Texas at San Antonio, San Antonio, TX, (4) University of Texas at San Antonio, San Antonio, TX, (5) University of Texas at San Antonio, San Antonio, TX, (6) University of Texas HSC SA, San Antonio, TX

RISE Research Initiative for Scientific Enhancement
BIO | BME | CHE | MAT | PHY | PSY

## INTRODUCTION

Gold nanoparticles (AuNPs) with unique optical properties are practical biosensors for dual usage in radiation therapy and CT imaging for the treatment of cancer. Using a simple and inexpensive technique, we recorded surface plasmonic resonance (SPR) absorption spectra and SPR scattering images from citrate-capped and PEGylated colloidal AuNPs. In this experiment, we compared citrate-capped AuNPs with PEGylated AuNPs to assess their amenability towards synthesis and functionalization in radiation therapy.

## AIM

- Biofunctionalize the AuNPs with carboxy-terminated PEG polymer and target them to cells, which can be conjugated with anti-EGFR antibodies through carbodiimide coupling to target epidermal growth factor receptor (EGFR)
- Cultured cells treated with targeted AuNPs, non-targeted AuNPs and no AuNPs will be irradiated in both external-beam and brachytherapy geometries.
- Radiobiological effects will be measured in terms of cell viability and reactive oxygen species generated

## METHOD

Fig. 1. Schematic representation of ~30 nm aqueous gold nanoparticle synthesis

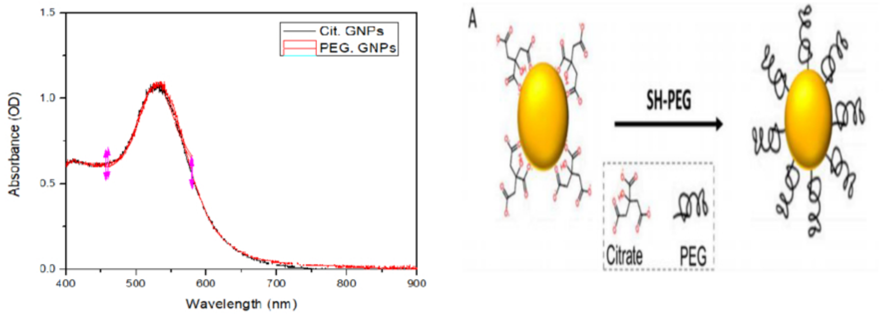


Fig 2. Schematic representation of a simple ligand exchange process by adding SH-PEG when AuNPs are citrate stabilized with UV-vis

## RESULTS

- The UV-vis spectra of the prepared PEGylated AuNPs exhibit an absorption maximum of 536.26 nm. In contrast, the citrate-capped AuNPs resulted in an absorption maximum of 534.17 nm
- SEM imaging of the citrate-capped AuNPs revealed that they are spherical particles approximately 30 nm in dimeter. In contrast, the PEGylated AuNPs which are approximately 48 nm in diameter.
- *Generation of fluorescence through excitation at 561 nm of PEGylated AuNPs using a 488 nm Argon laser unit show favorable results for fixed and live cell analysis for targeting and non-targeting in vitro experiments.*

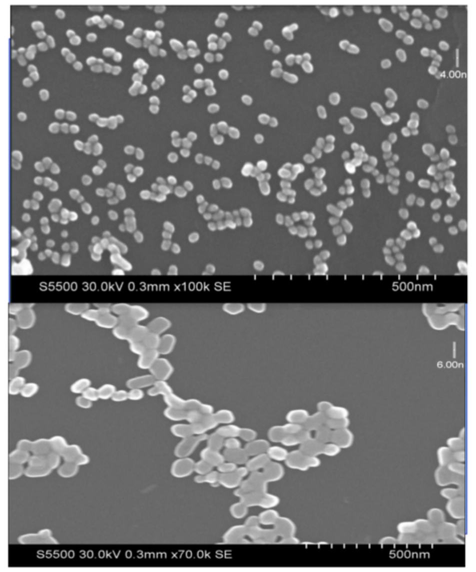


*Fig 3. SEM images of as-synthesized gold AuNPs: (a) ~30 nm citrate-capped AuNPs; (b) ~ 48 nm PEGylated AuNPs*

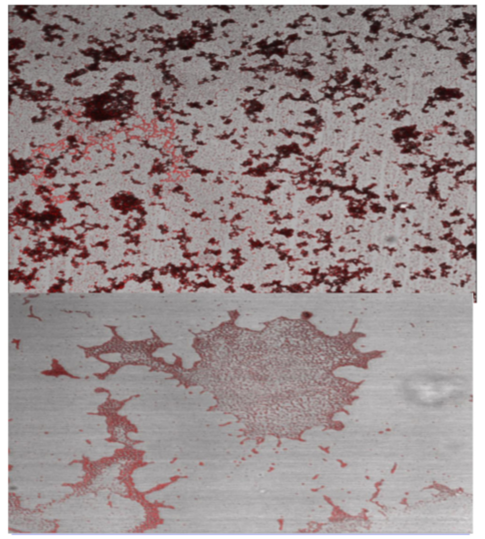

*Fig 4: Brightfield optical images of (a) citrate and (b) PEGylated AuNPs immobilized on a glass substrate*

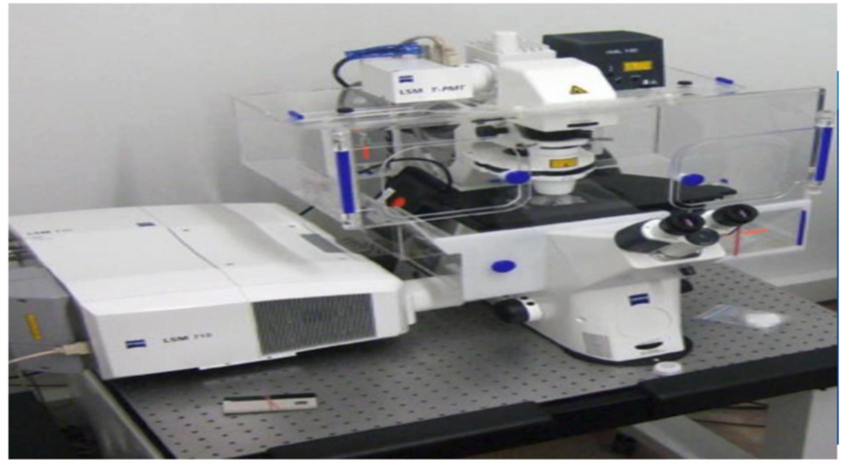

*Fig 5: The Zeiss 710 confocal point-scanning microscope*

## CONCLUSIONS

- The results show that we have successfully functionalized spherical AuNPs 30 nm in diameter with biocompatible polymer PEG, replacing the citrate layer on as-synthesized NPs.
- Our future work is to apply these PEG-functionalized nanoparticles to active targeting delivery in in vitro studies of nanoparticle-enhanced radiation therapy for cervical cancer.

## REFERENCES

1. Guerrini, L., et al. (2018). "Surface modifications of nanoparticles for stability in biological fluids." Materials **11**(7): 1154.
2. Ngumbi, P. K., et al. "Determination of Gold Nanoparticles Sizes via Surface Plasmon Resonance."
3. Rahme, K., et al. (2013). "PEGylated gold nanoparticles: polymer quantification as a function of PEG lengths and nanoparticle dimensions." Rsc Advances **3**(17): 6085-6094.
4. Ghosh, P., et al. (2008). "Gold nanoparticles in delivery applications." Advanced drug delivery reviews **60**(11): 1307-1315.

## ACKNOWLEDGEMENTS

- Research reported in this poster was supported by the Research Initiative for Scientific Enhancement Grant

## CONTACT INFORMATION

Shaquan David
University of Texas at San Antonio
Shaquan.david@utsa.edu