LIST OF TABLES

3.1 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under an excitation wavelength of 514 nm

3.2 Raman peaks and the corresponding assignments in the conventional and SERS spectra of CV under an excitation wavelength of 514 nm

4.1 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under different excitation lines for which maximum enhancement was observed

4.2 Raman peaks and the corresponding assignments in the conventional and SERS spectra of CV using an excitation wavelength of 785 nm

5.1 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under different excitation lines

5.2 Raman peaks and the corresponding assignments in the conventional and SERS spectra of CV under different excitation lines

5.3 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under different excitation lines

5.4 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under different excitation lines

6.1 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under an excitation wavelength of 514 nm
6.2 Raman peaks and the corresponding assignments in the conventional and SERS spectra of 2-ATP under an excitation wavelength of 514 nm

7.1 Comparison of enhancement factor of different samples
# LIST OF FIGURES

1.1 Schematic representation of the origin of surface plasmon resonance 7

2.1 Schematic representation of a dual beam UV-visible absorption spectrophotometer 30

2.2 Schematic representation of a spectrofluorophotometer 32

2.3 Schematic diagram showing the working of FTIR spectrometer 34

2.4 Schematic representation of micro Raman spectrometer 36

2.5 Schematic representation of two-photon absorption 39

2.6 Schematic representation of three-photon absorption 41

2.7 Schematic representation of reverse saturable absorption 42

2.8 Schematic representation of open aperture z-scan setup 46

2.9 Schematic representation of a typical TEM components 48

2.10 Principle of EDX 51

2.11 Condition for constructive interference 52
3.1 Absorption spectra of colloidal Au nanoparticles prepared with different HAuCl₄ concentrations: (a) 2.5, (b) 5, (c) 7.5, (d) 10, (e) 12.5, (f) 15 and (g) 17.5 mL. Inset shows the variation of SPR bandwidth with concentration of HAuCl₄

3.2 TEM, HRTEM and SAED pattern of Au nanoparticles prepared with: (a) 2.5 mL HAuCl₄ concentration; (b) 2.5 mL PEG and 2.5 mL HAuCl₄ concentrations; (c) 12.5 mL PEG and 2.5 mL HAuCl₄ concentrations and (d) 10 mL HAuCl₄ and 12.5 mL PEG concentrations

3.3 Absorption spectra of PEG stabilized colloidal Au nanoparticles prepared with different PEG concentrations: (a) 2.5, (b) 5, (c) 7.5, (d) 10, (e) 12.5 and (f) 17.5 mL. Inset shows the variation of SPR bandwidth with concentration of PEG

3.4 EDS spectrum of Au nanoparticles prepared with 2.5 mL HAuCl₄ and 12.5 mL PEG

3.5 Absorption spectra of colloidal Au nanoparticles prepared with 12.5 mL PEG with different HAuCl₄ concentrations: (a) 2.5, (b) 5, (c) 7.5, (d) 10, (e) 12.5, (f) 15 and (g) 17.5 mL. Inset shows the variation of SPR bandwidth with concentration of HAuCl₄

3.6 Absorption spectra of PEG stabilized colloidal Au nanoparticles with various pH values: (a) 6, (b) 4, (c) 3 and (d) 2

3.7 Absorption spectra of PEG stabilized colloidal Au nanoparticles with various pH values: (a) 6, (b) 7, (c) 8, (d) 9 (e) 10 and (f) 10.5

3.8 (a) Normal Raman spectrum of 2-ATP; SERS spectrum of 2-ATP on Au nanoparticles of different sizes: (b) 4.3, (c) 5.9, (d) 10, and (e) 12 nm
3.9 (a) Normal Raman spectrum of CV; SERS spectrum of CV on Au nanoparticles of different sizes: (b) 12, (c) 10, (d) 5.9 and (e) 4.3 nm

3.10 Variation of SERS enhancement factor of 2-ATP with particle size

3.11 Variation of SERS enhancement factor of CV with particle size

3.12 Open-aperture z-scan curves and the variation of input laser intensity vs. normalized transmittance curve of gold nanoparticles of different sizes: (a) 4.3, (b) 5.8, (c) 10 and (d) 12. Open circles show the experimental data and the solid lines show the numerical fits

4.1 UV-vis absorption spectra of Au nanorods prepared with different AgNO₃ concentrations: (a) 0, (b) 40, (c) 100, (d) 140, (e) 200, (f) 240, (g) 300 and (h) 350 µL

4.2 Variation of LSPR peak with concentration of AgNO₃

4.3 TEM images of Au nanorods synthesized with different AgNO₃ concentrations: (a) 40, (b) 100, (c) 140, (d) 200, (e) 240 and (f) 350 µL under different magnifications

4.4 HRTEM and SAED pattern of Au nanorods synthesized with different AgNO₃ concentrations: (a) 200 and (b) 240 µL

4.5 UV-vis absorption spectra of Au nanorods prepared with different ascorbic acid concentrations: (a) 50, (b) 60, (c) 70, (d) 80 and (e) 90 µL

4.6 UV-vis absorption spectra of Au nanorods prepared with different seed concentrations: (a) 4, (b) 6, (c) 8, (d) 10, (e) 12, (f) 15 and (g) 20 µL

4.7 UV-vis absorption spectra of Au nanorods prepared at different pH conditions: (a) 4, (b) 3, (c) 2, (d) 1
4.8 UV-vis absorption spectra of Au nanorods prepared at different pH conditions: (a) 5, (b) 6, (c) 7, (d) 8 and (e) 10

4.9 TEM images of Au nanorods synthesized with different pH: (a) 3 and (b) 8

4.10 (a) Normal Raman spectrum of 2-ATP; SERS spectrum of 2-ATP using 785 nm excitation line on Au nanorods of different aspect ratios: (b) 2.4, (c) 3.8, (d) 4.2, (e) 5.8 and (f) 16

4.11 SERS spectra of 2-ATP on Au nanorods using different excitation lines: (a) 514 nm on rod with aspect ratio 2.4; 1064 nm on rods with different aspect ratio (b) 5.8 and (c) 16

4.12 Variation of SERS enhancement factor of 2-ATP on different aspect ratio of nanorods using 785 nm excitation line

4.13 (a) Normal Raman spectrum; SERS spectrum of crystal violet using 785 nm excitation on Au nanorods of different aspect ratios: (b) 2.4, (c) 5.8 and (d) 16. Inset shows the molecular structure of CV

4.14 Variation of SERS enhancement factor of crystal violet with aspect ratio of Au nanorods. Excitation is at 785 nm

4.15 Input laser intensity vs. normalized transmittance curve of gold nanorods of aspect ratio (a) 2.4, (b) 3.8, (c) 4.2, and (d) 5.8. Inset shows the corresponding open-aperture Z-scan curves. Open circles show the experimental data and the solid lines show the numerical fits

4.16 Variation of nonlinear absorption coefficient ($\beta$) with: (a) aspect ratio of Au nanorods and (b) TSPR intensity

5.1 Photograph of Cinnamomum zeylanicum leaf used in the present study
5.2 UV-vis absorption spectra of colloidal Au nanoparticles prepared with different leaf broth concentrations: (a) 4, (b) 6, (c) 8, (d) 10, (e) 12, (f) 15, (g) 17 and (h) 20 mL. Inset shows the UV-vis-NIR absorption spectra of colloidal Au nanoparticles prepared with different leaf broth concentrations: (a) 4, (b) 6, (c) 8 and (d) 10 mL.

5.3 TEM, HRTEM and SAED patterns of Au colloids reduced with different leaf broth quantities (a) 4, (b) 6, (c) 8, (d) 10 and (e) 17 mL.

5.4 XRD pattern of Au colloid synthesized using Cinnamomum zeylanicum leaf broth concentration of 17 mL.

5.5 FTIR spectrum of Au colloid synthesized using Cinnamomum zeylanicum leaf broth concentration of 17 mL.

5.6 Photoluminescence spectra of colloidal Au nanoparticles at different leaf broth concentrations: (a) 4, (b) 6, (c) 8, (d) 10, (e) 12, (f) 15, (g) 17 and (h) 20 mL. Inset shows the PL spectra of the leaf broth.

5.7 (a) Normal Raman spectrum of 2-ATP; SERS spectrum of 2-ATP on Au nanoparticles: (b) and (c) prepared with 4 and 8 mL leaf broth concentrations using 785 nm excitation line; (d) prepared with 17 mL leaf broth concentrations using 514 nm excitation line. Inset shows the molecular structure of 2-ATP.

5.8 (a) Normal Raman spectrum of CV; SERS spectrum of CV on Au nanoparticles: (b) and (c) prepared with 4 and 8 mL leaf broth concentrations using 785 nm excitation line; (c) prepared with 17 mL leaf broth concentrations using 514 nm excitation line.

5.9 Antibacterial activity against gram negative bacterium *Escherichia coli* and gram positive bacterium *Staphylococcus aureus* of Au nanoparticles.
prepared with (a) 4 mL, (b) 8 mL and (c) 17 mL leaf broth concentrations

5.10 Antifungal activity against *Aspergillus niger* and *Fusarium oxysporum* positive of Au nanoparticles prepared with: (a) 4 mL, (b) 8 mL and (c) 17 mL leaf broth concentrations

5.11 Photograph of Vitis californica leaf used in the present study

5.12 UV-vis absorption spectra of colloidal Au nanoparticles prepared with different leaf broth concentrations: (a) 0.5, (b) 1, (c) 2.5, (d) 5, (e) 7.5, (f) 10, (g) 15 and (h) 20 mL. Inset shows the UV-vis-NIR absorption spectra of colloidal Au nanoparticles prepared with different leaf broth concentrations: (a) 0.5, (b) 1 and (c) 2.5 mL

5.13 TEM, HRTEM and FFT patterns of Au colloids reduced with different leaf broth quantities: (a) 0.5, (b) 1, (c) 2.5, (d) 15 and (e) 20 mL

5.14 XRD pattern of Au colloid synthesized with 20 mL Vitis californica leaf broth concentration

5.15 FTIR spectrum of: (a) Vitis californica leaf broth, (b) Au colloid synthesized with 20 mL Vitis californica leaf broth concentration

5.16 (a) Normal Raman spectrum of 2-ATP; SERS spectrum of 2-ATP on Au nanoparticles: (b) and (c) prepared with 0.5 and 1 mL leaf broth concentrations using 785 nm excitation line respectively; (d) prepared with 20 mL leaf broth concentrations using 514 nm excitation line. Inset shows the molecular structure of 2-ATP

5.17 (a) Normal Raman spectrum of CV; SERS spectrum of CV on Au nanoparticles: (b) and (c) prepared with 0.5 and 1 mL leaf broth concentrations using 785 nm excitation line respectively; (d) prepared...
with 20 mL leaf broth concentrations using 514 nm excitation line. Inset shows the molecular structure of CV

5.18 Antimicrobial activity against gram positive bacterium *Staphylococcus aureus* and gram negative bacterium *Escherichia coli* of Au nanoparticles prepared with: (g1) 0.5 mL, (g2) 1 mL and (g3) 20 mL leaf broth concentrations

5.19 Antifungal activity against *Aspergillus niger* and *Fusarium oxysporum* positive of Au nanoparticles prepared with: (g1) 0.5 mL, (g2) 1 mL and (g3) 20 mL leaf broth concentrations

6.1 UV-visible absorption spectra of: (a) Au colloid; Au-Ag bimetallic nanoparticles with different Au:Ag compositions: (b) Au$_{85}$Ag$_{15}$, (c) Au$_{73}$Ag$_{27}$, (d) Au$_{54}$Ag$_{46}$, (e) Au$_{40}$Ag$_{60}$ and (f) Au$_{21}$Ag$_{79}$

6.2 TEM image, HRTEM image and SAED pattern of Au-Ag bimetallic nanoparticles prepared with Au-Ag compositions: (a) Au$_{85}$Ag$_{15}$, (b) Au$_{73}$Ag$_{27}$ and (c) Au$_{54}$Ag$_{46}$

6.3 (a) Normal Raman spectrum of 2-ATP; SERS spectrum of: (b) Au nanoparticles; Au:Ag bimetallic nanoparticles with different Au:Ag compositions: (c) Au$_{85}$Ag$_{15}$, (d) Au$_{73}$Ag$_{27}$ and (e) Au$_{60}$Ag$_{40}$

6.4 (a) Normal Raman spectrum of CV; SERS spectrum of: (b) Au nanoparticles; Au:Ag bimetallic nanoparticles with different Au:Ag compositions: (c) Au$_{85}$Ag$_{15}$, (d) Au$_{73}$Ag$_{27}$ and (e) Au$_{60}$Ag$_{40}$

7.1 Absorption spectra, TEM images, SERS spectra of 2-ATP and CV molecules of samples A, B, C and D (sample codes as given in Table 7.1): Normal Raman spectrum (NR) of 2-ATP and CV molecules