Synthesis and Characterization of Novel Nanomaterials for SERS Biomedical/Environmental Application

Sabancı Üniversitesi

PURE PROGRAM FOR UNDERGRADUATE RESEARCH

Student(s)

Ammar Khan
Finesa Xhibo
Necla Yücel
Sena Turan

Faculty Member(s)

Anjum Qureshi,
Javed Kolkar

Introduction

With nanotechnology receiving so much interest in recent years, it has become imperative to synthesize nanoparticles in a way that is cost effective, environmentally friendly and viable.

Silver nanoparticles (Ag NPs) that are stabilized with a permeable layer of long-chain polyethylene glycol (PEG) are effective surface-enhanced Raman scattering (SERS) substrates for bioanalytical applications.

What is SERS?

The surface-enhanced Raman scattering (SERS) is an advanced Raman technique that enhances the vibrational spectrum of molecules adsorbed on or in the vicinity of metal particles.

SERS provides a unique opportunity to detect neurotransmitters such as Dopamine in human serum

SERS Signal | Laser

SERS Substrate

What is Dopamine?

Dopamine (DA) is a neurotransmitter that is widely distributed in the brain tissues and body fluids of mammals.

The abnormal variation of the DA concentration in the body has been linked to serious neurological, renal, cardio disorders such as schizophrenia, Huntington's disease, Alzheimer's disease, and Parkinson's disease.
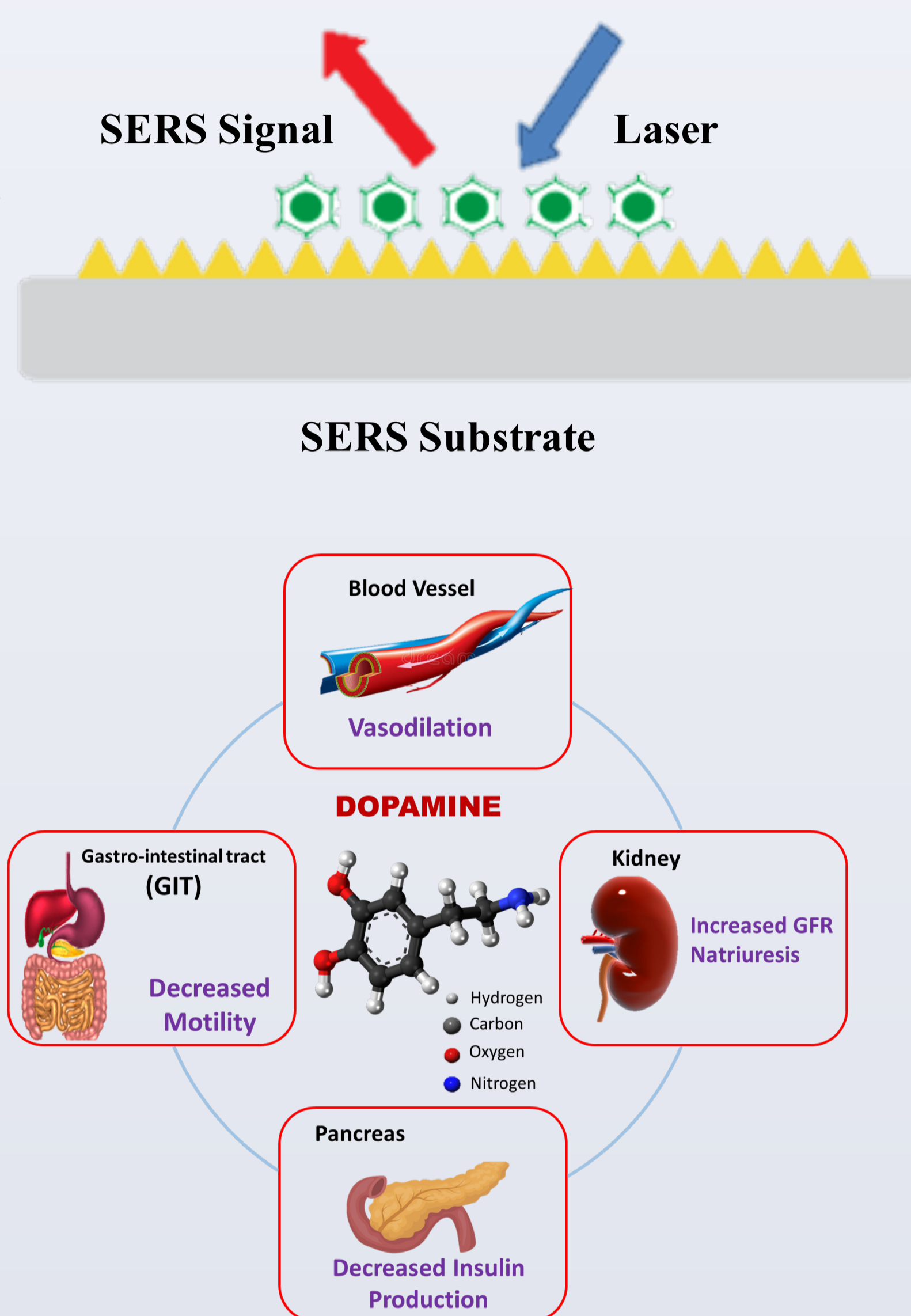
What is Green Method ?

Great efforts are made to use environmentally friendly methods for the synthesis of noble metal nanoparticles . This is achieved mostly by the use of plant or fruit extracts and bioorganisms. [1]

These green methods are low cost, fast, efficient and generally lead to the formation of crystalline nanoparticles. [1]
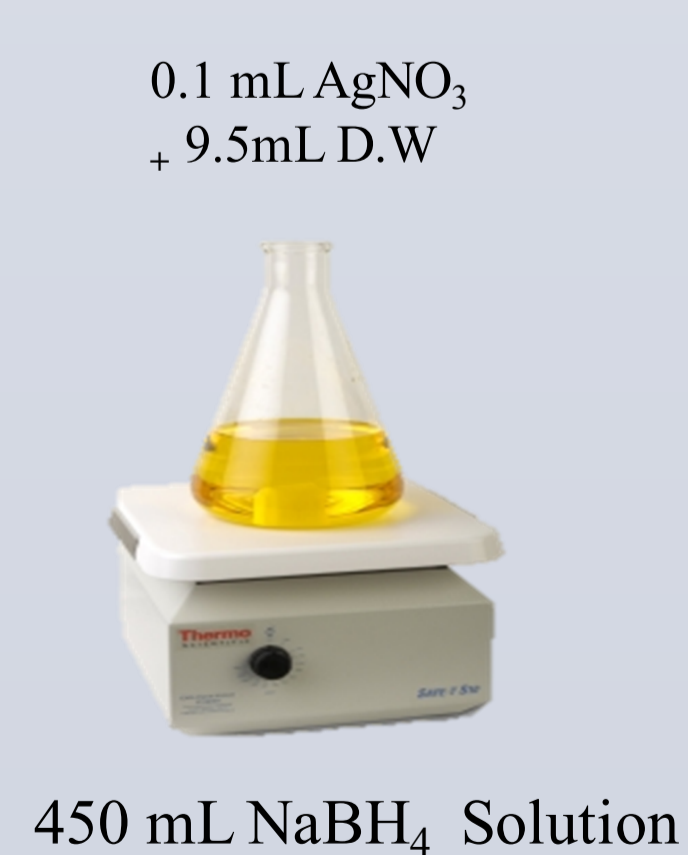
Objectives

- Synthesise Synthesize Ag SERS substrate by green method.
- Characterize these particles using UV-Vis, XRD, FTIR
- Use this SERS substrate to detect the dopamine level in our body.

Experimental

Synthesis of Functionalised Ag-NPs

0.1 – 0.3 mL $AgNO_3$

0.5 mL PEG | 10 mL $NaBH_4$ Solution
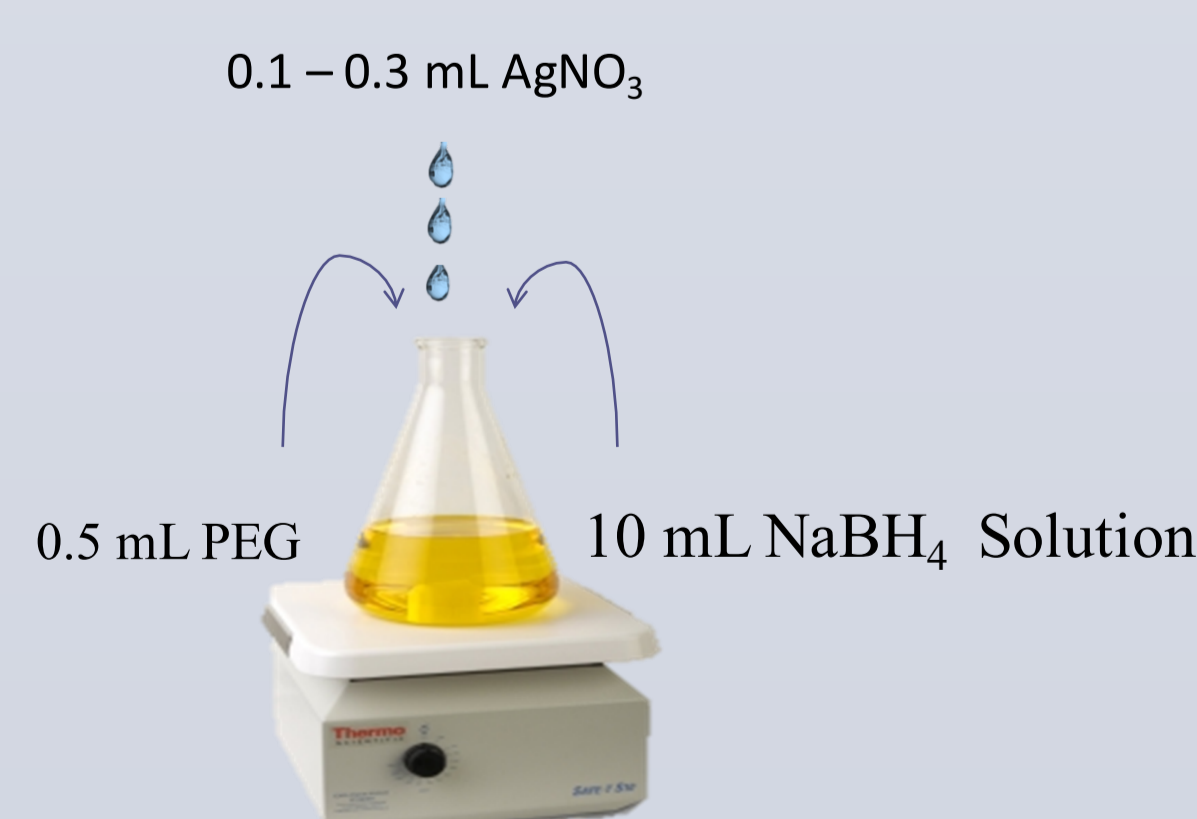
Synthesis of Non-Functionalised Ag-NPs

0.1 mL $AgNO_3$ + 9.5mL D.W

450 mL $NaBH_4$ Solution

| Sample No	Sample Name
1-2	Non-Functionalised Ag NPs without Dopamine
3-4	Non-Functionalised Ag NPs with Dopamine
5-6	Functionalized Ag NPs without Dopamine
7-8	Functionalised Ag NPs with Dopamine
9	Dopamine
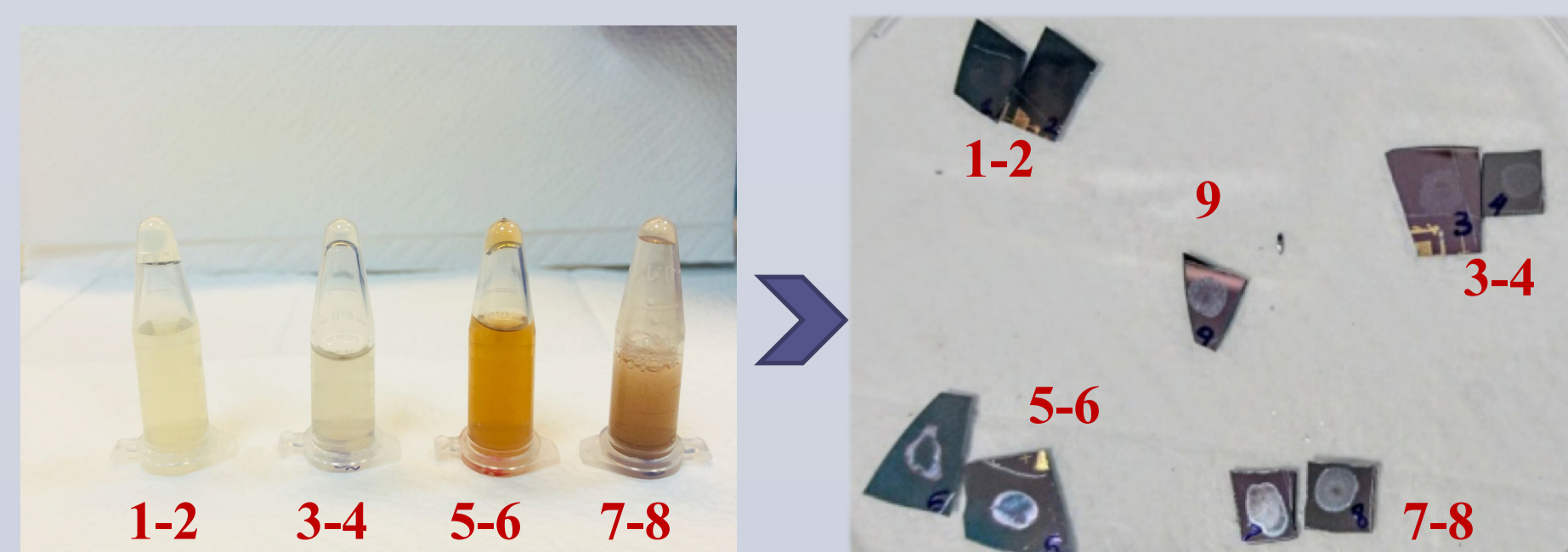
Characterization
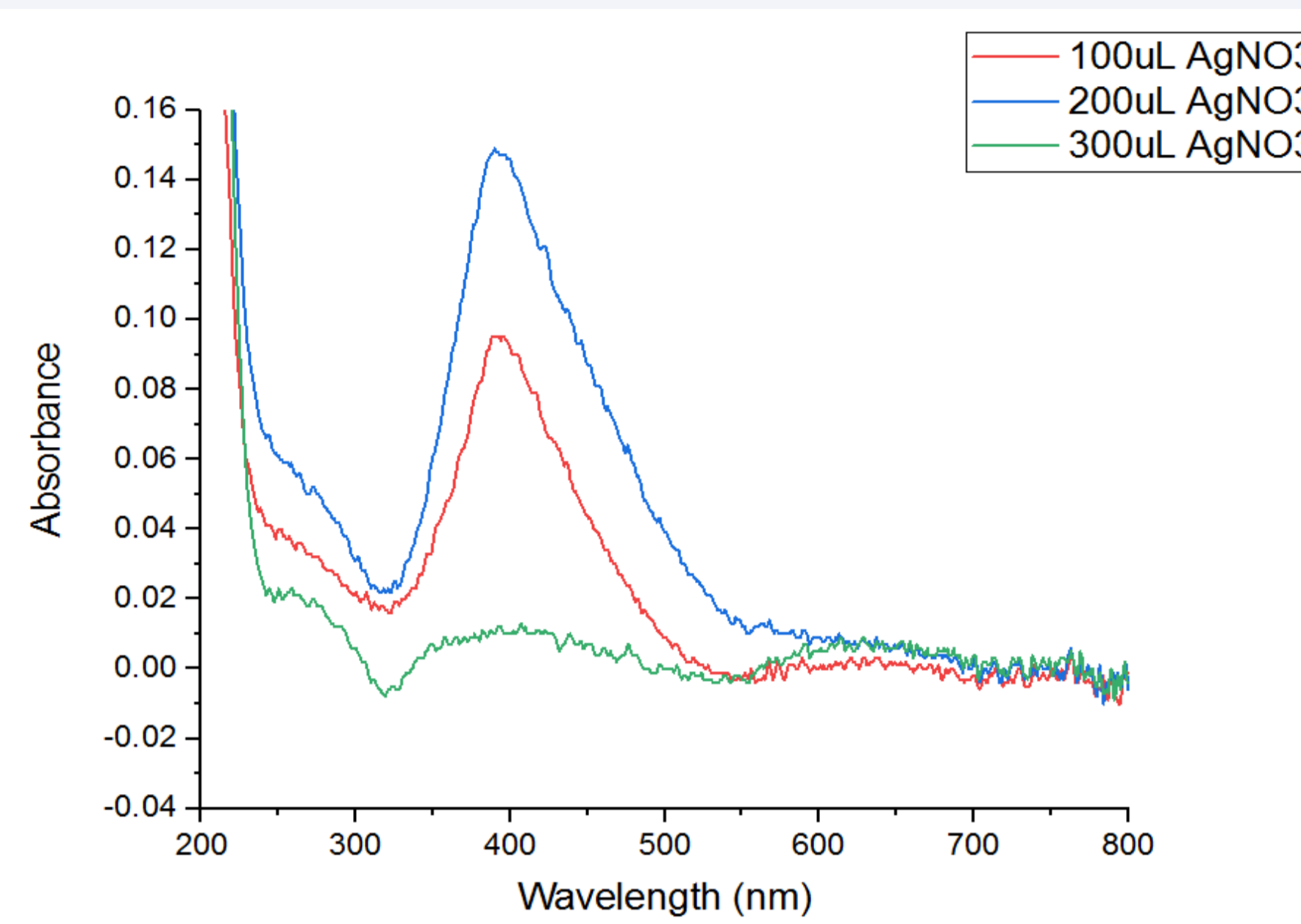
UV-Vis Spectrophotometry:

The absorbance spectrum of the colloidal sample was obtained in the range of 200–800 nm, using a UV–Vis spectrometer Nanodrop 2000 with distilled water as a reference.

In order to characterize our functionalized samples, 0.02 mL was taken from each of the three samples prepared and analysed.
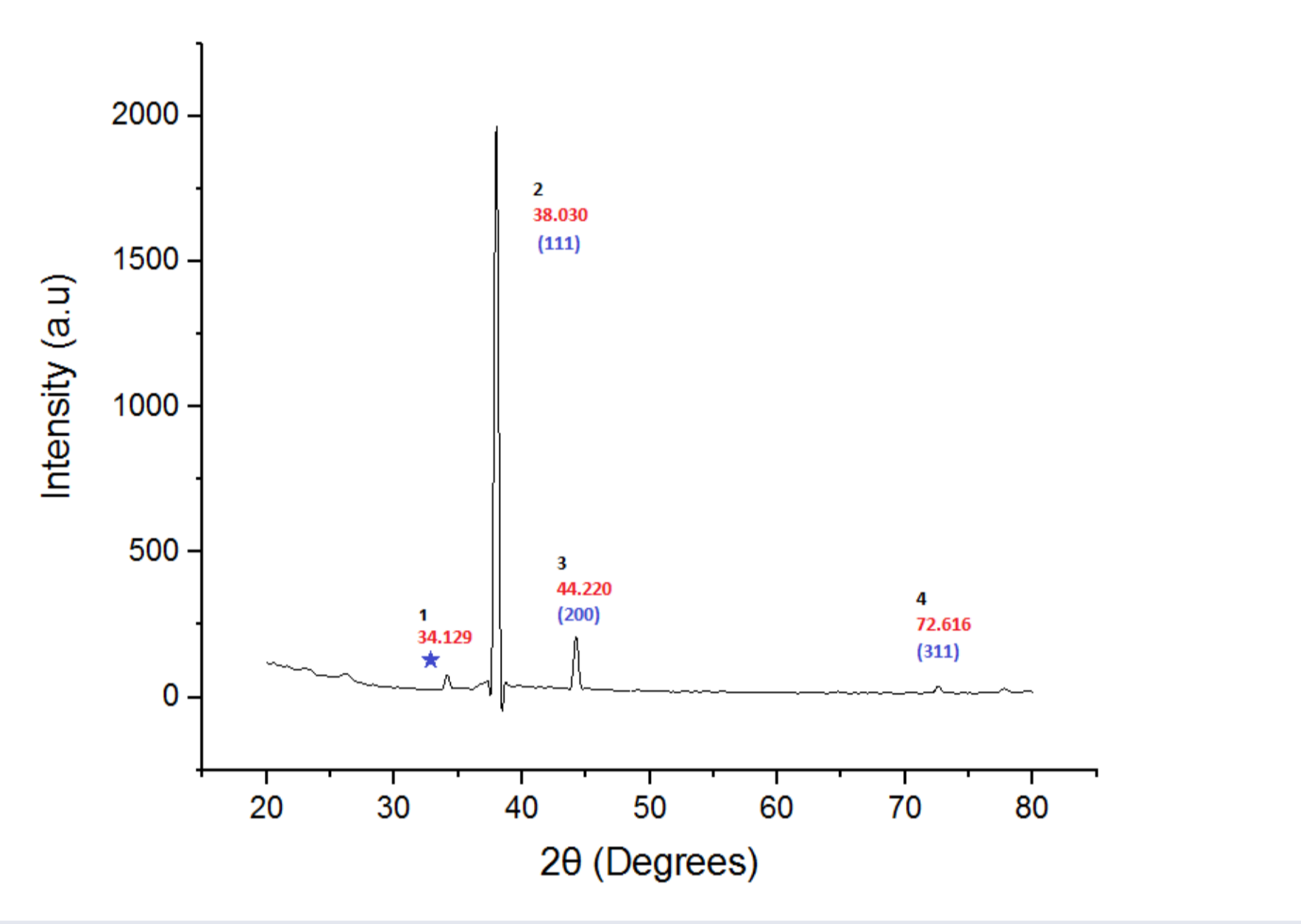

X – Ray Diffraction (XRD):

Data was taken for the 2θ range of 20 to 80 degrees with a step of 0.02 degree.

The XRD study has thus confirmed that the resultant particles in the prepared sample are silver nanoparticles having face centered cubic crystal structure.
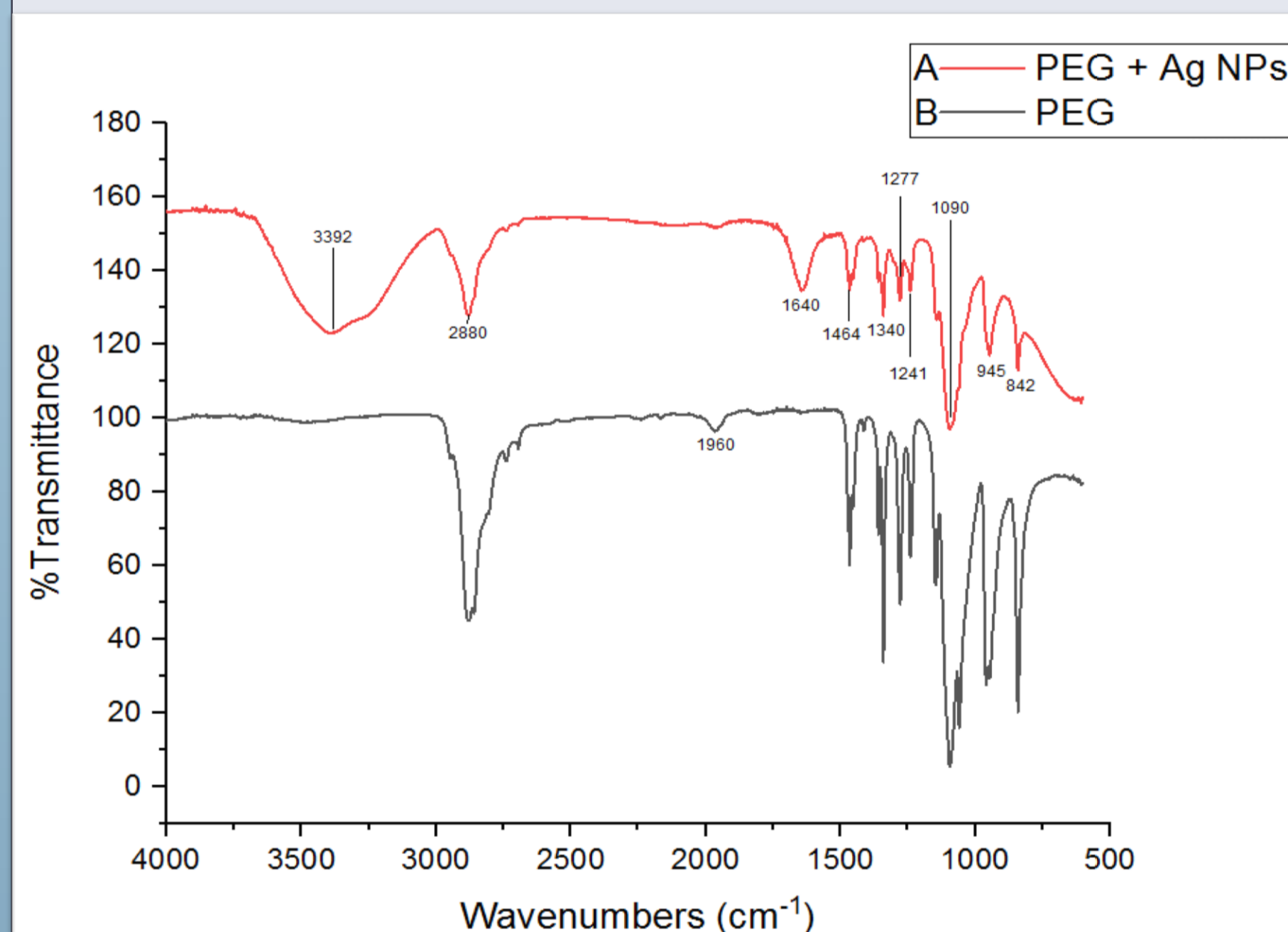
Fourier-Transform Infrared Spectroscopy (FTIR):

Nitrogen gas was added to PEG compounds and Silver nanoparticles with PEG to was determined whether the two compounds are the same, the state of the bonds in the structure, binding sites and whether the structure is aliphatic or aromatic.
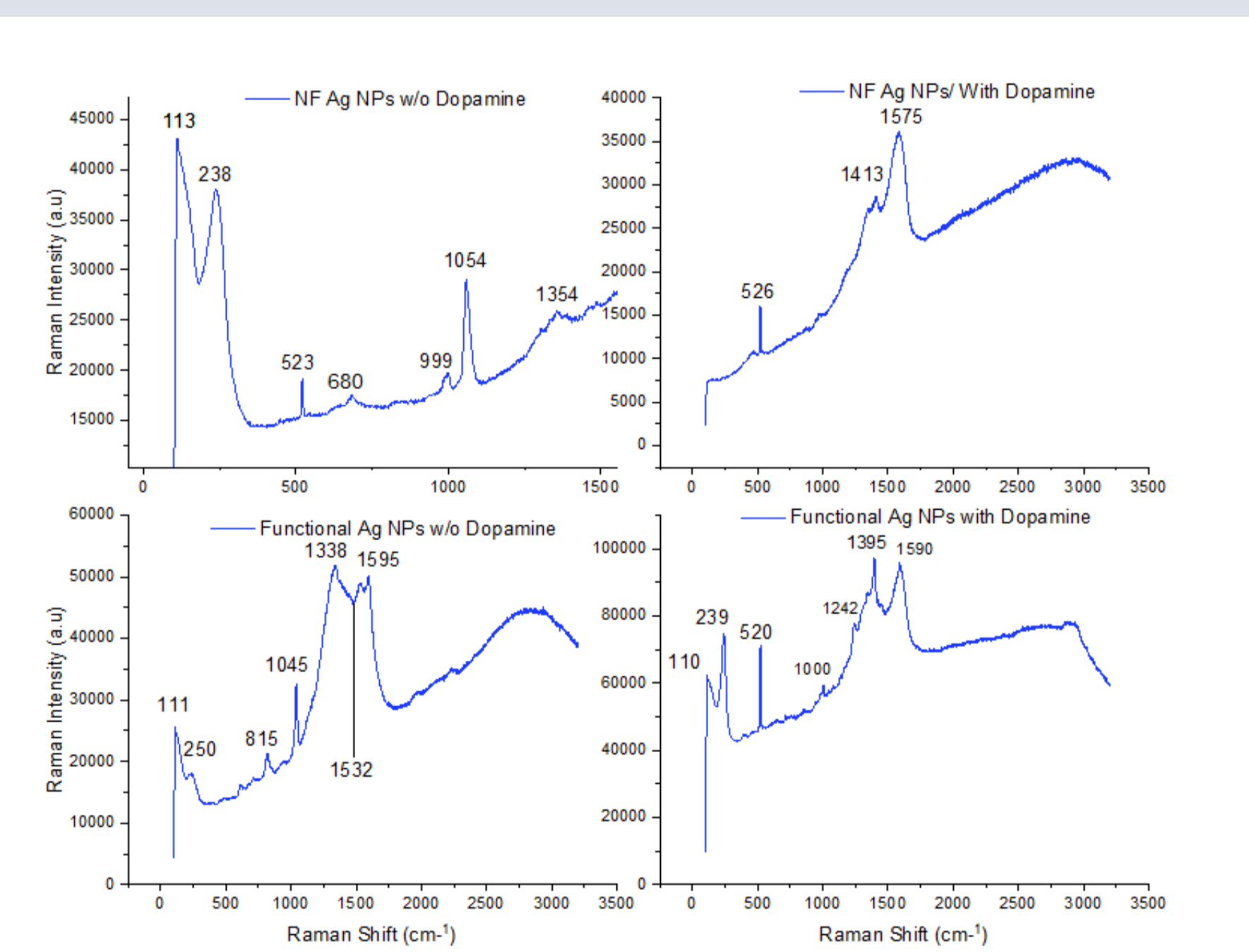
Raman Spectroscopy:

Surface Enhancement Raman Spectroscopy (SERS): Functionalized and Non-Functionalized Ag NPs, detection of Dopamine was analyzed via Raman Spectroscopy. Functionalized Ag NPs showed more right shift and the peak confirms that Functionalized Ag NPs have successfully detected dopamine.

Conculusion

The surface-enhanced Raman scattering (SERS) was realized use Silver nanoparticles. Functionalized and Non-functionalized Silver nanoparticles were synthesized use silver nitrate, sodium, and dopamine. Ag- NPs were characterized by Uv-Vis Spectra, XRD, FTIR and Raman Spectra. The graphs were analyzed. Then, the biomedical and environmental use of silver nanoparticles dropped onto silicate floors was tested

References

[1]   Green synthesis and characterization of silver nanoparticles produced using Arbutus Unedo leaf extract / Pantelis Kouvaris, Andreas Delimitis, Vassilis Zaspalis, Dimitrios Papadopoulos, Sofia A. Tsipas, Nikolaos Michailidis