Separation and SERS detection of dye mixture on silver nanoparticles

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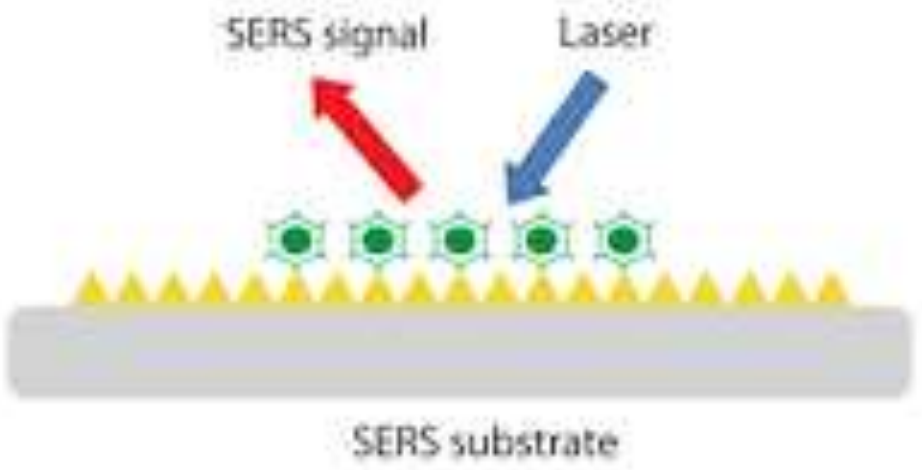
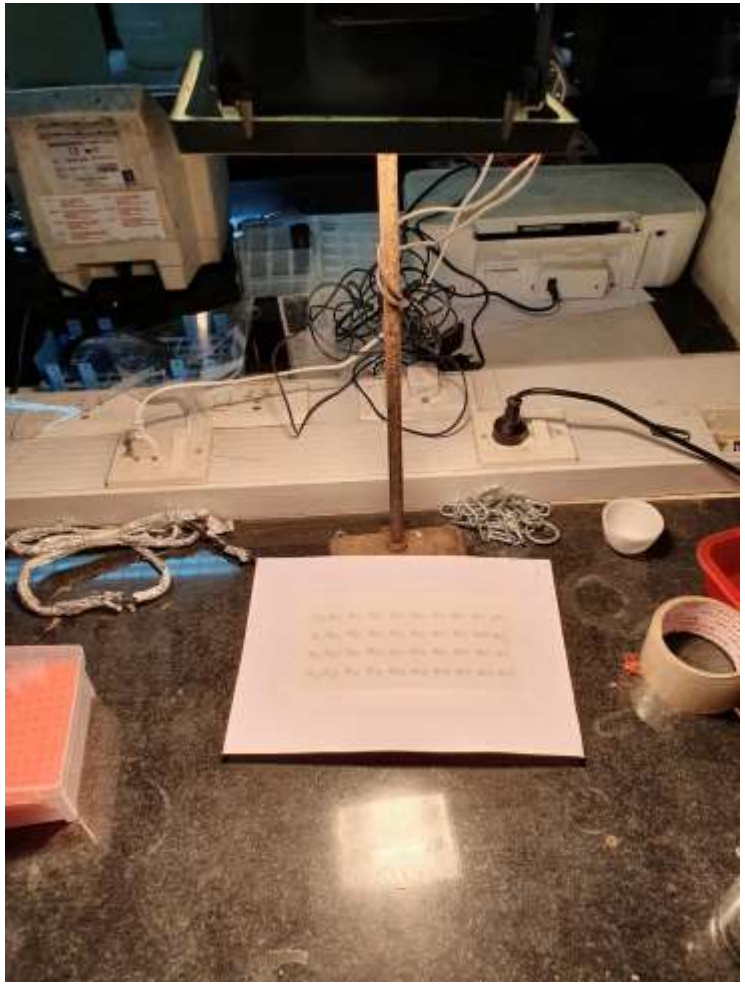
SERS Detection

- Surface Enhanced Raman Spectroscopy (SERS) is a capable technique for rapid, on-field detection of molecules
- Pesticides are mixed with surfactants and Preservatives before applying them on crops and fruits.
- So if the active ingredient is not separated from the additives the spectra we get could be inconclusive
- As a result we decided to test out the separation techniques on some common dyes like R6G , Metanil Yellow(MY) and Methylene Blue(MB)

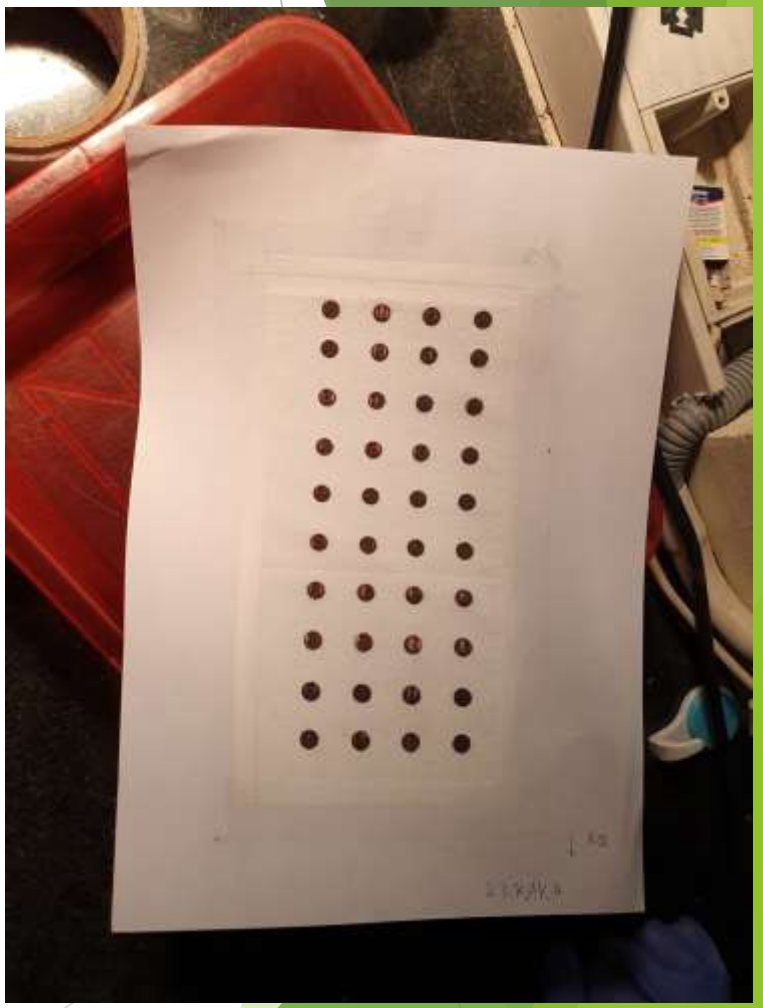


Fabrication of Silver Nanoparticles on Kimwipe tissue

Print alternate layers of AgNO3(1M) & KCL(2M)

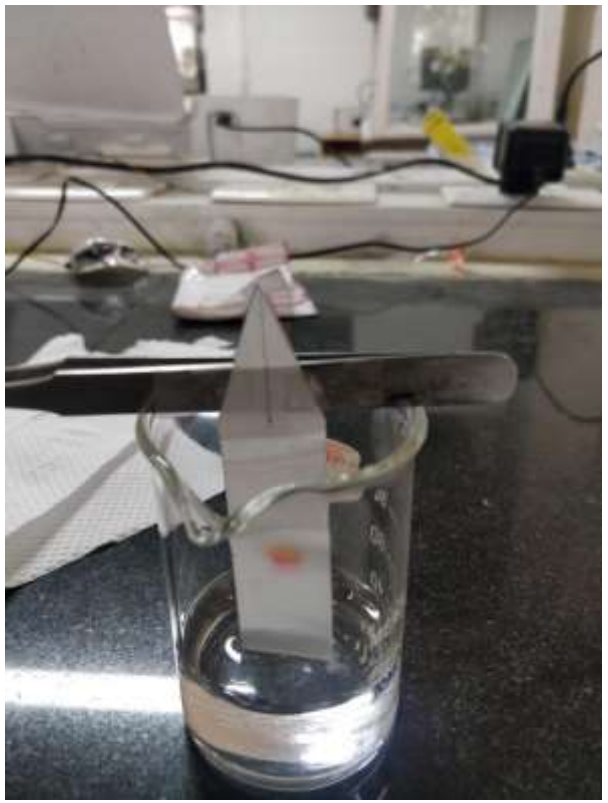


Expose Under Halogen Light for 10 mins



Develop using D 76 for 10 mins

Separation and detection of 2 dye mixture (1mM R6G + MY)



Separation of 1 mm mixture of R6G and metanil Yellow using chromatography paper (Solvent is 70% acetonitrile)

Transference of dye from chromatography paper to silver substrate using pure acetonitrile

Separation of 3 dye mixture (R6G+MY+MB)

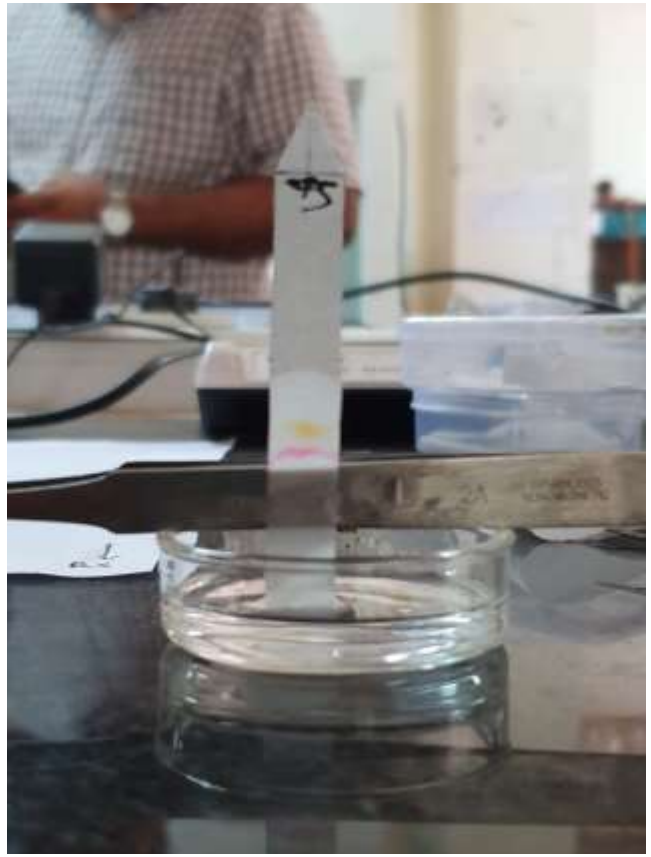
- A mixture of 1mM R6G , MY and MB of equal vol (1ml each) was prepared

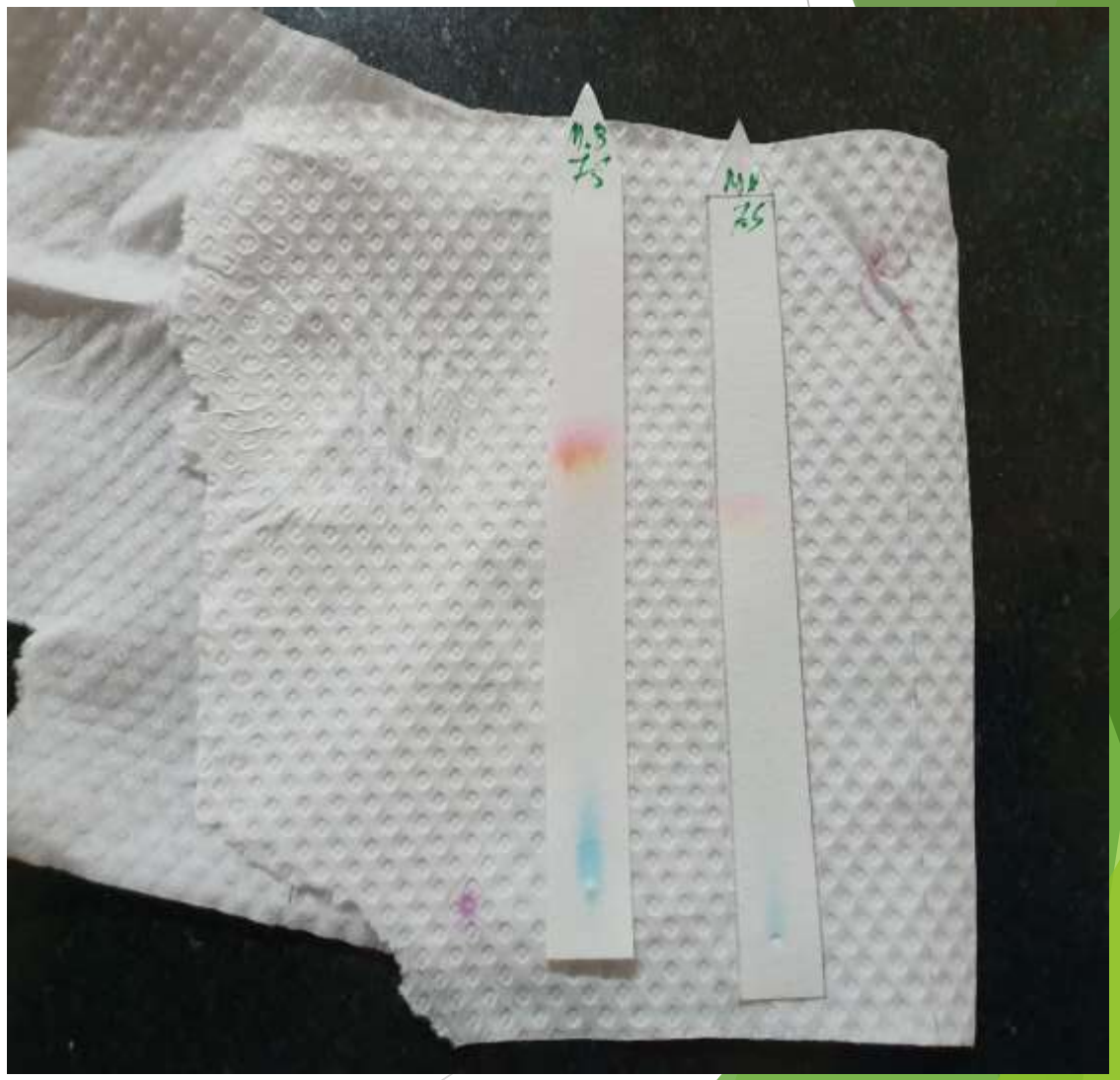
Solvents Used :

- Chloroform
- Hexane
- Toulene
- IPA
- Methanol
- Ethanol
- DI water
- Di-chloromethane

Decided on a two step using various combination of Methanol & Ethanol :

1. Use 75% Methanol + 25% Ethanol Combination to separate MB from the mixture
2. Use 60% Methanol + 40% Ethanol solution to separate MY from R6G



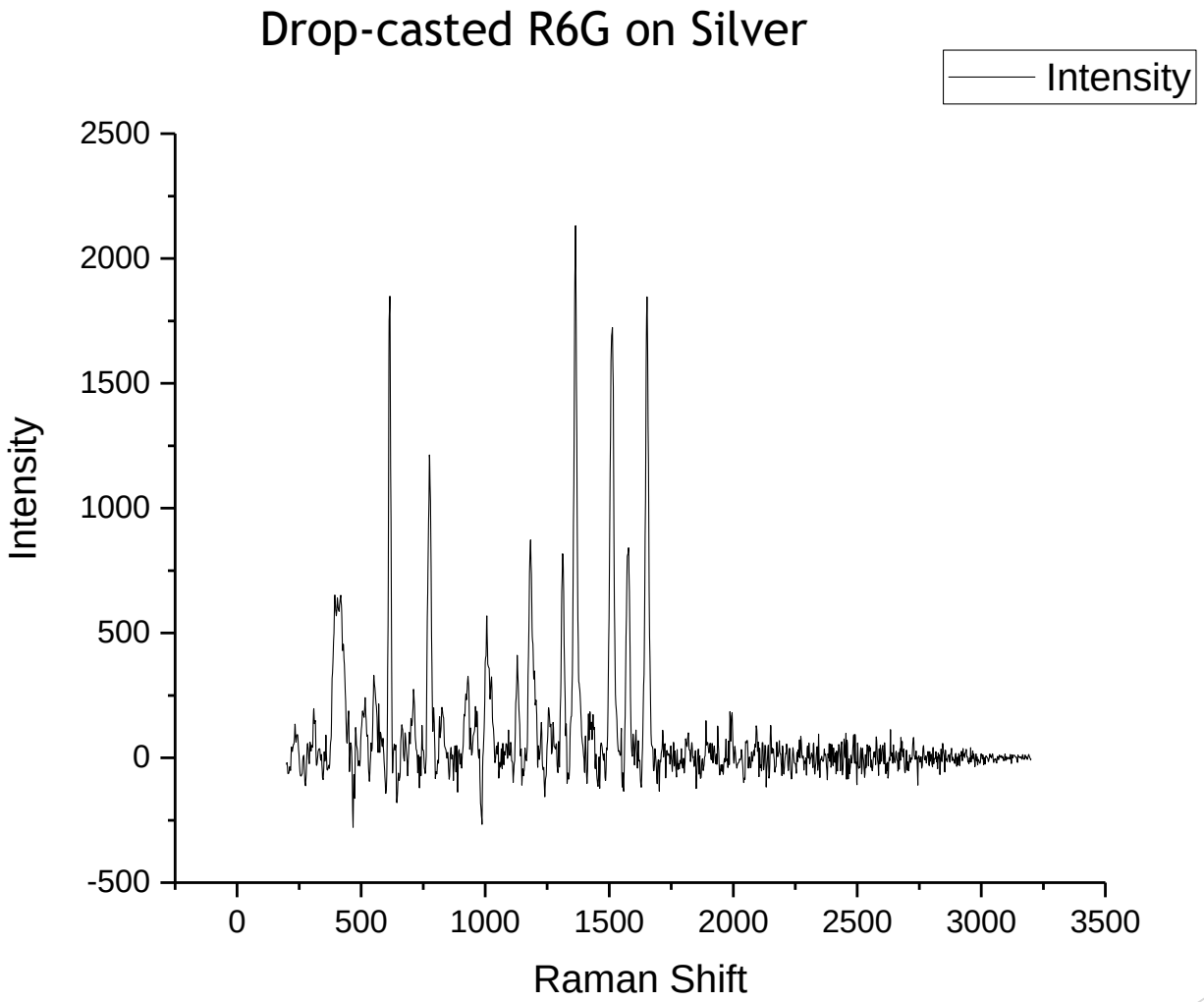


Detection Process

- Solvent Used : Acetonitrile

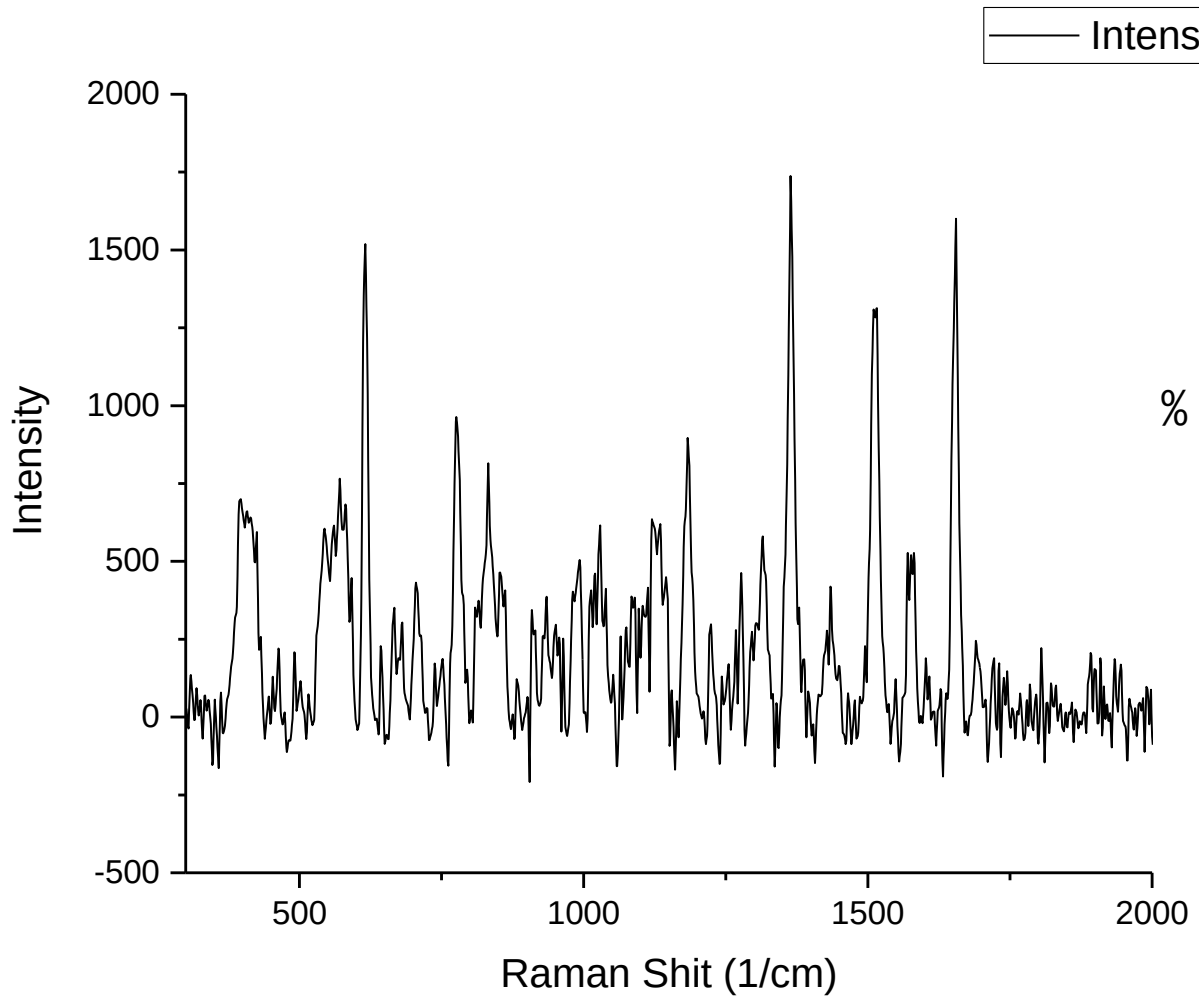
R6G

Rhodamine 6G (R6G) dye (616 cm-1peak)



Integrated Area = 20020.29061

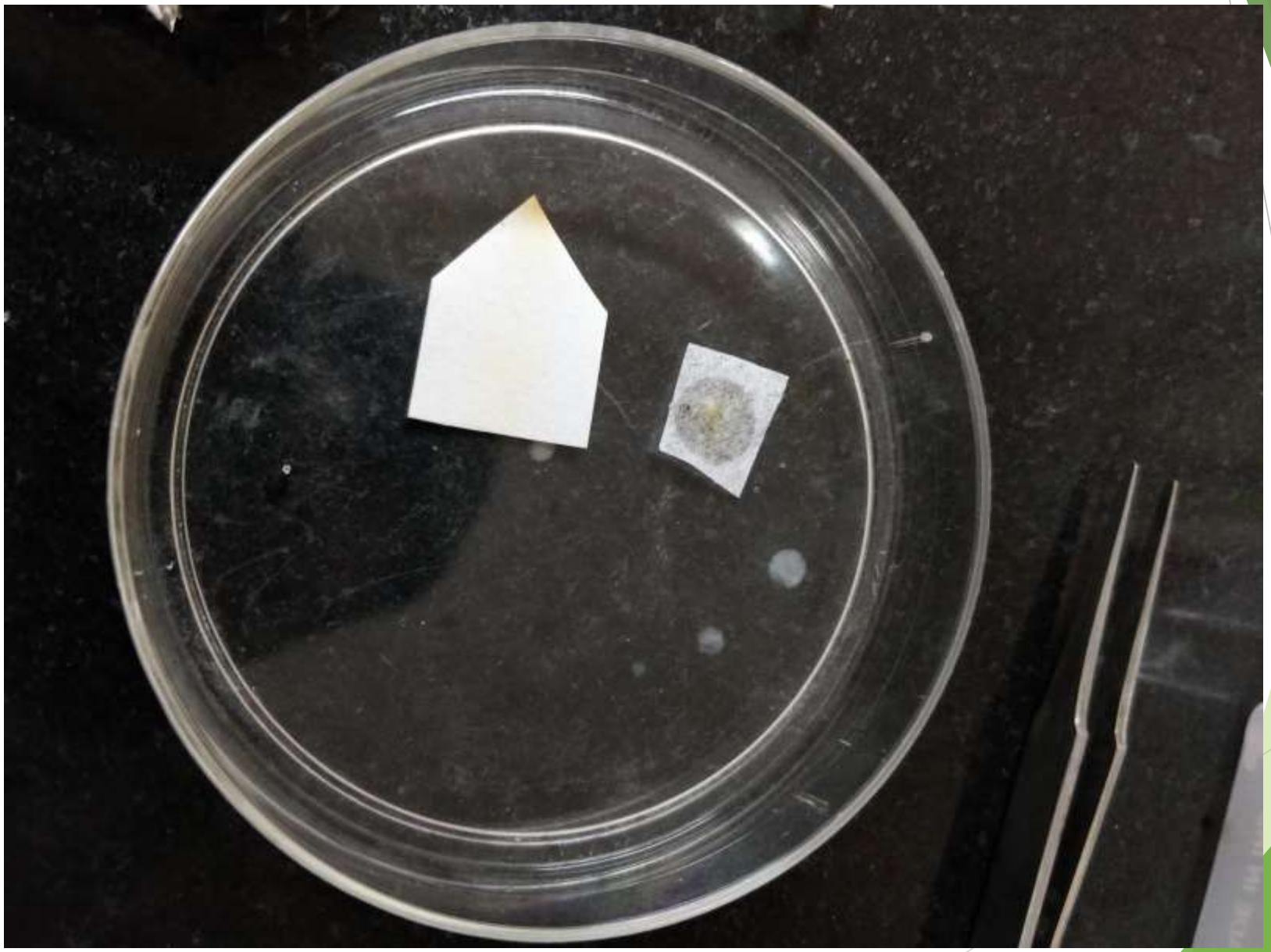
Transferred R6G



% Reduction in area = 13.99

Integrated Area = 17218.82862

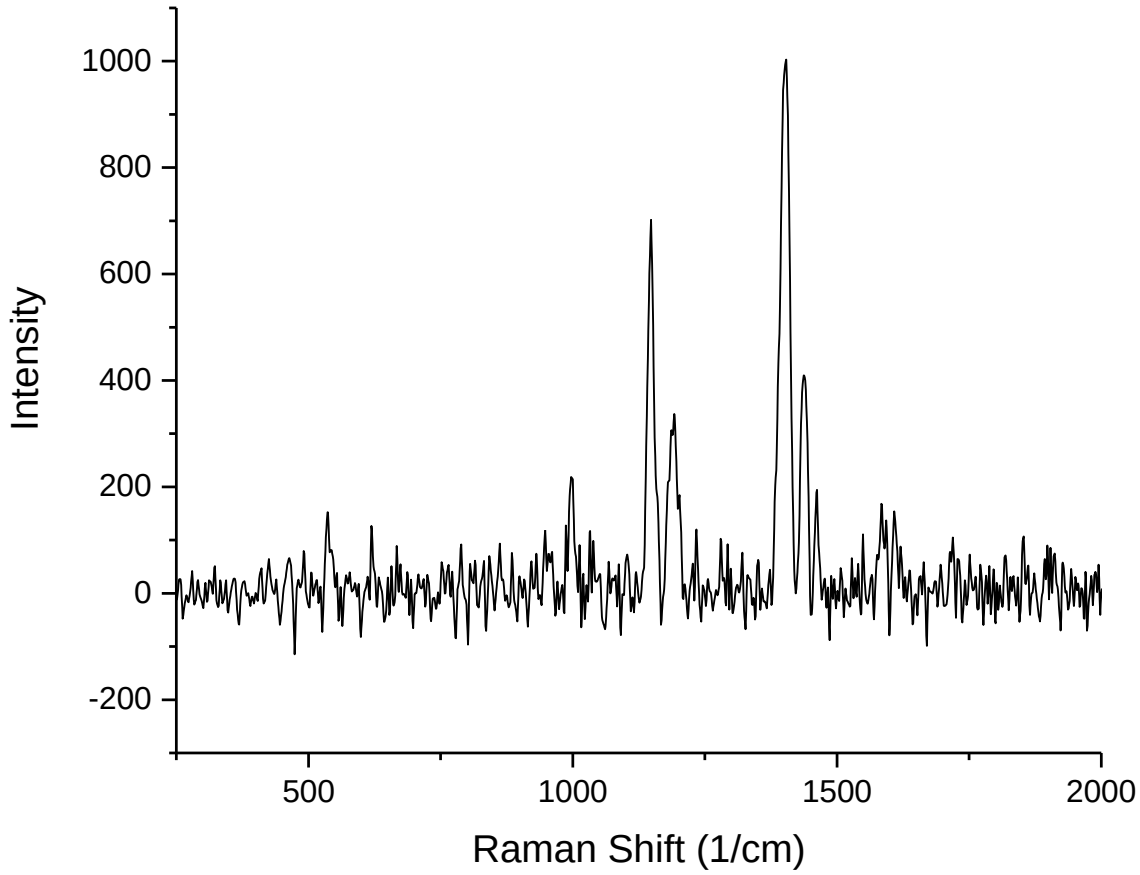
MY



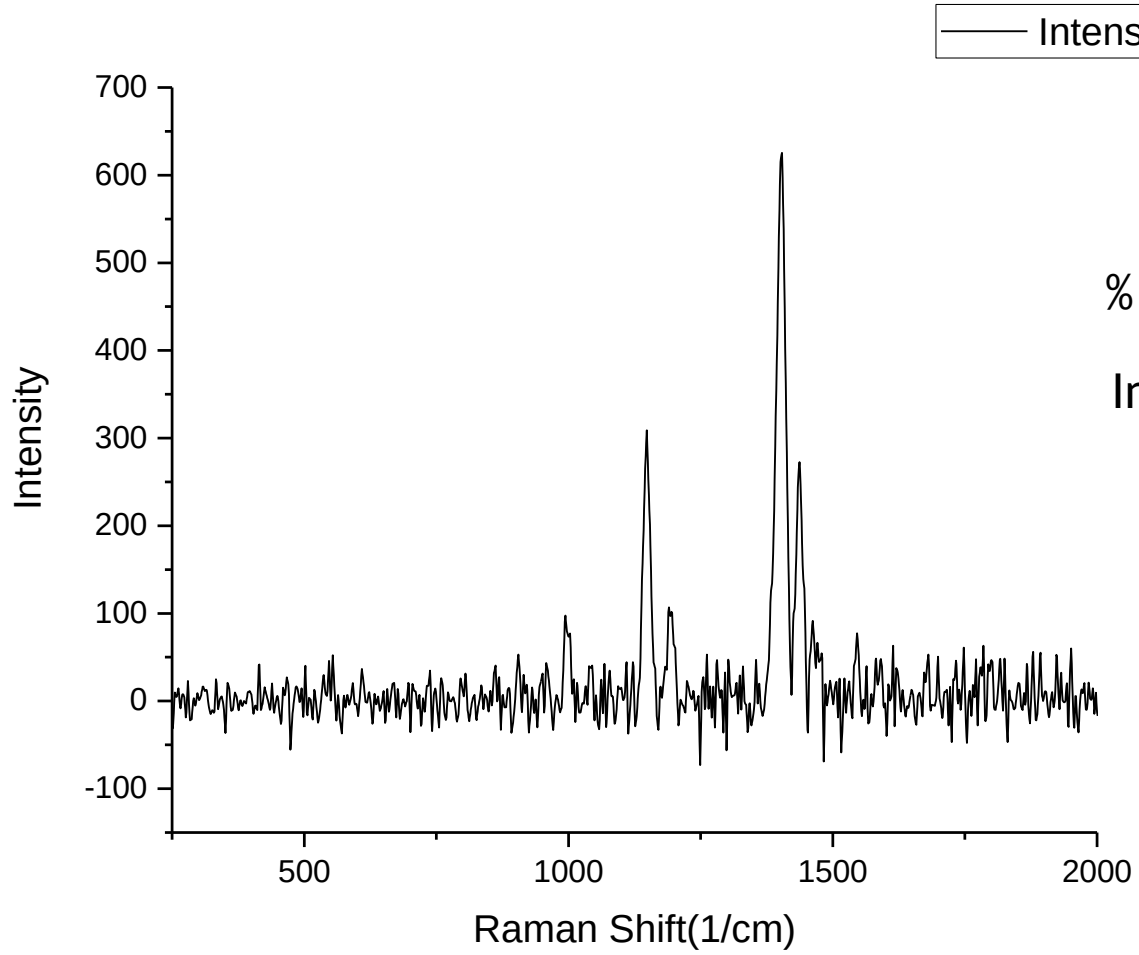
Metanil Yellow

Different peaks in the SERS Spectra :
1193 cm-1 & 1437 cm-1 (v(N=N)) peaks
1147 cm-1 (v(C-Nazo) stretching)
1406 cm-1 (S=O stretching)

Dropcasted MY on silver nanoparticle
Integrated area = 10697.73801



Transferred MY

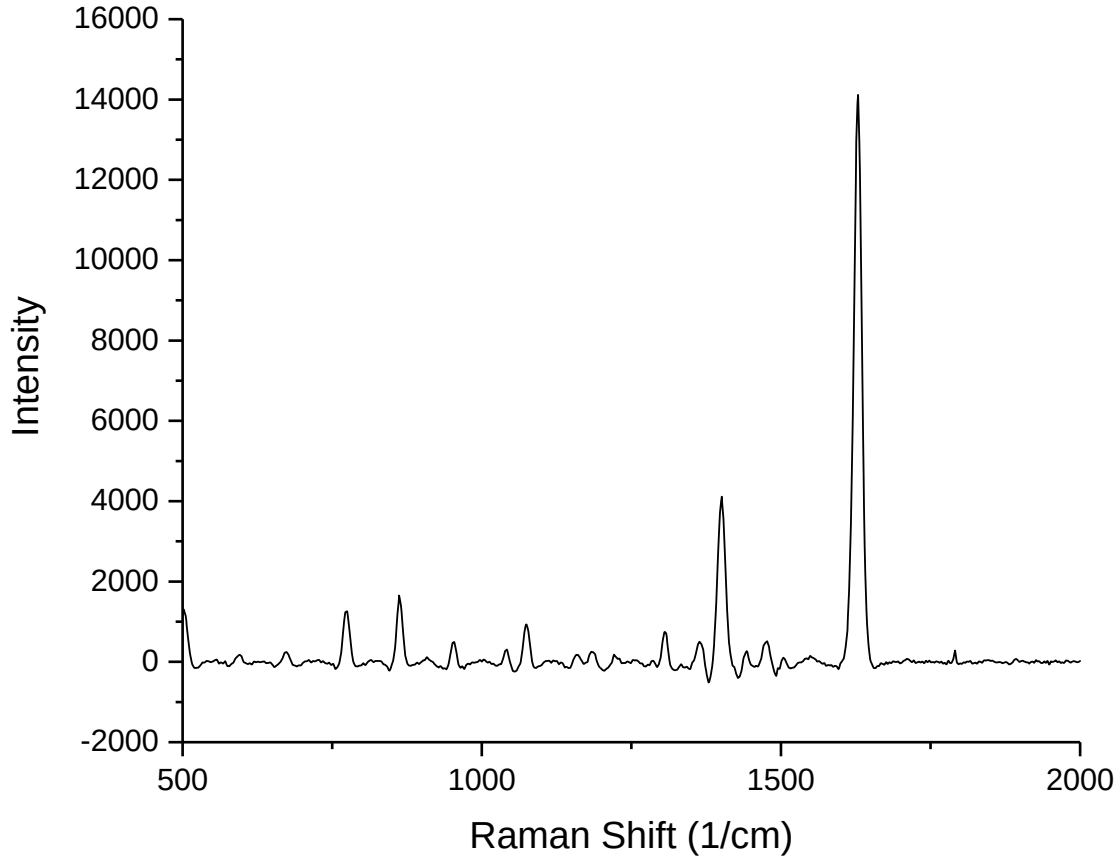


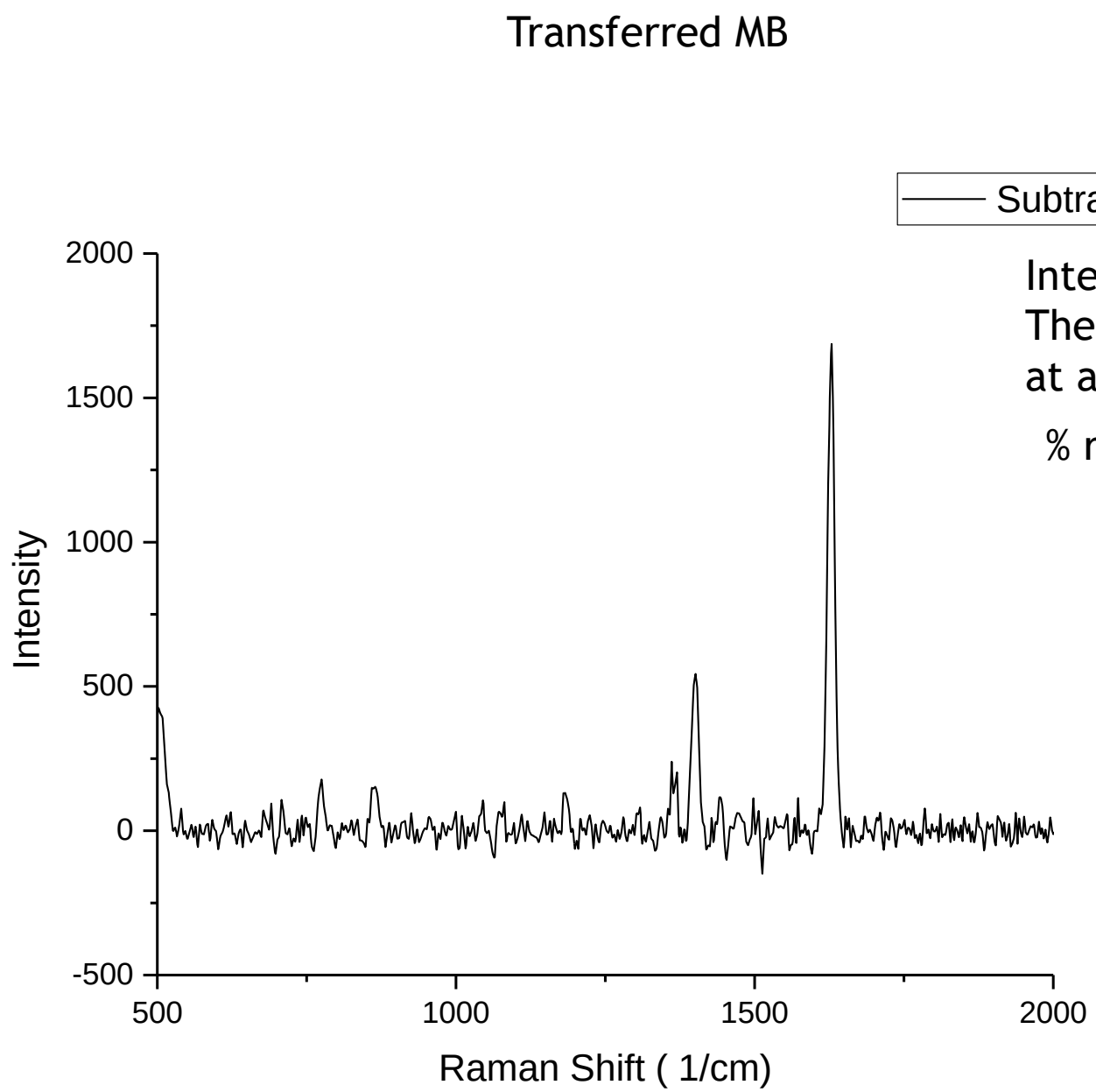
% reduction in area = 23.11

Integrated area = 8225.4329

Methylene Blue

Dropcasted MB on silver nanoparticle
Integrated Area = 33374.7813





Integrated Area = 29552.30355

The characteristic peaks of MB at around 1621, 1385 cm-1

% reduction in area = 11.45

Conclusion

- Separation, Transference and SERS detection of Dyes is possible and yield positive results
- Current process yields positive results but only for mixtures at higher concentration as they are visible to the naked eye
- Concentration process needs to be mechanized.

THANK YOU