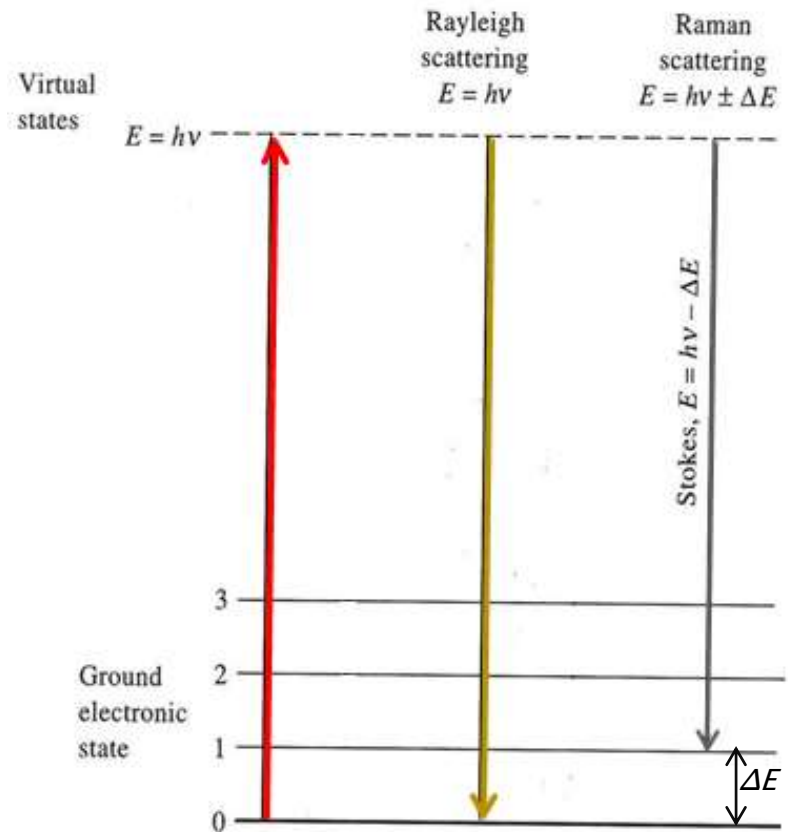
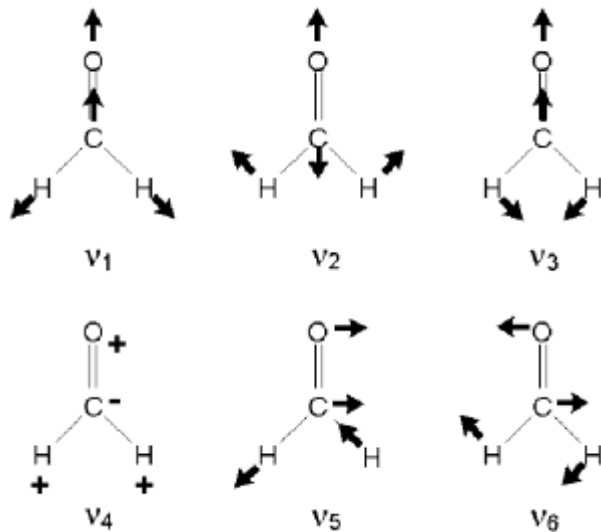


Raman Dye Library for Multiplex Bioassay Development

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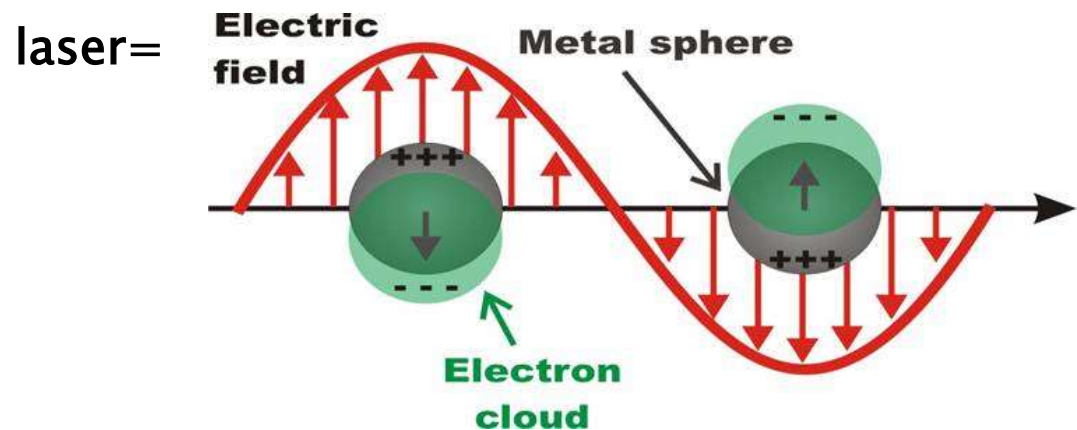
Raman Spectroscopy

- ▶ Vibrational spectroscopic technique
- ▶ Inelastic scattering
 - 1 / 1,000,000 photons scattered



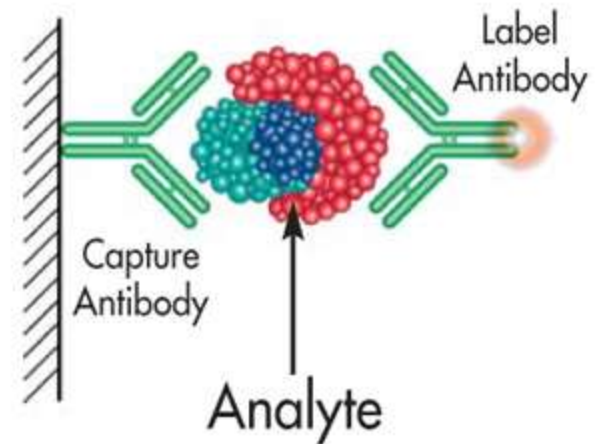
Surface Enhanced Raman Spectroscopy (SERS)

- ▶ Use Au, Ag or Cu surfaces
- ▶ 10^5 – 10^{16} intensity enhancement
 - Typical $\sim 10^7$ – 10^8 enhancement
- ▶ Localized surface plasmons



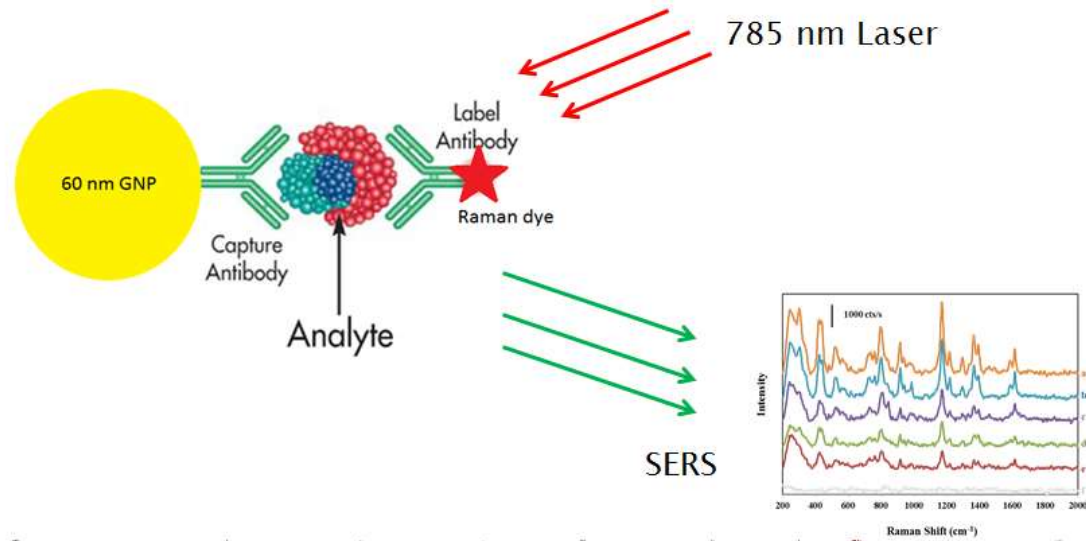
What is a Bioassay ?

- ▶ Diagnostic technique
 - Non-invasive
 - Quick detection
 - Accurate
- ▶ Allow capture of biomolecules
 - Antibodies / Antigens
 - Viruses (DNA)
 - miRNA
- ▶ Need long shelf life



SERS Based Bioassay

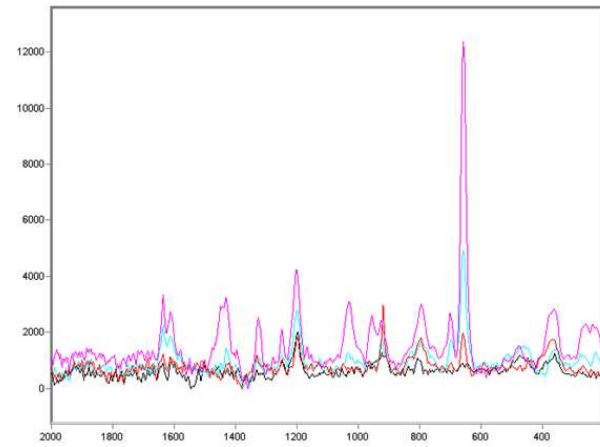
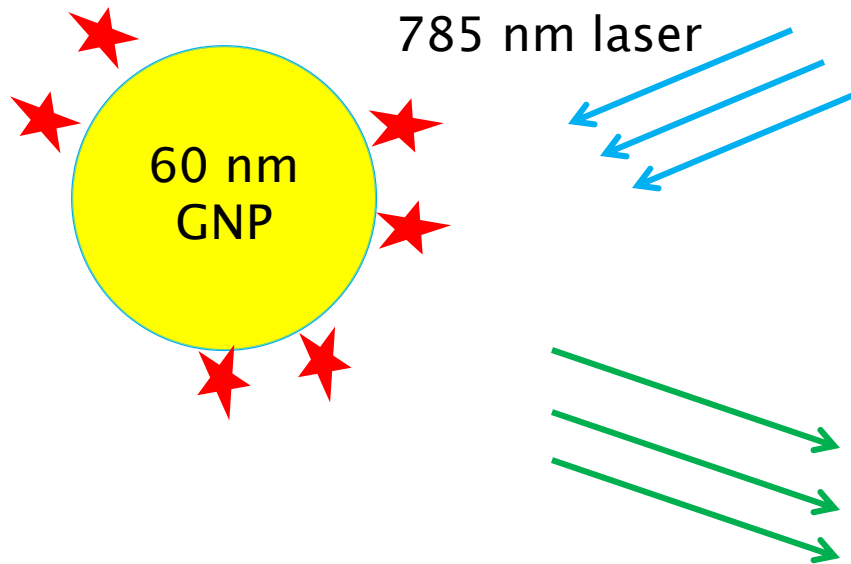
- ▶ 60 nm Gold Nanoparticle (GNP)
 - SERS surface
- ▶ Capture Antibody
 - Provides specificity for target analyte
- ▶ Analyte
- ▶ Label Antibody
 - Free in solution
 - Raman dye



My Project

- ▶ Dye library
 - 20+ dyes
 - Identify characteristic peaks
 - Solubility
 - Examples:
 - Nile Blue
 - IR-792
 - Malachite Green-ITC
 - Methylene Blue
- ▶ Multiplex
 - 3-5 dyes detected simultaneously
 - Raman spectrum has narrow spectral peaks

My Project



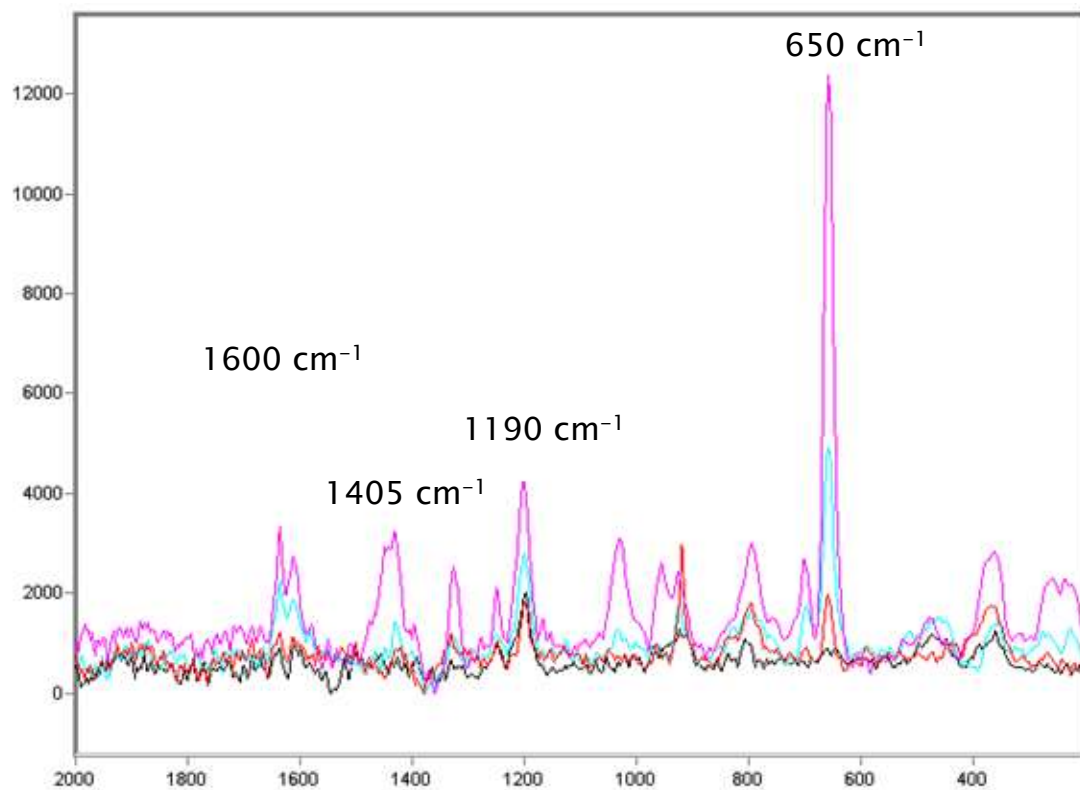
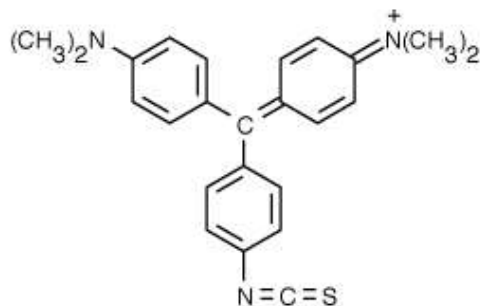
Intensity / Wavenumber (cm-1)

Overlay Z-Zoom CURSOR

Dye Library Malachite Green-ITC

▶ Characteristic Peaks:

- 650 cm^{-1}
- 1190 cm^{-1}
- 1405 cm^{-1}
- 1600 cm^{-1}



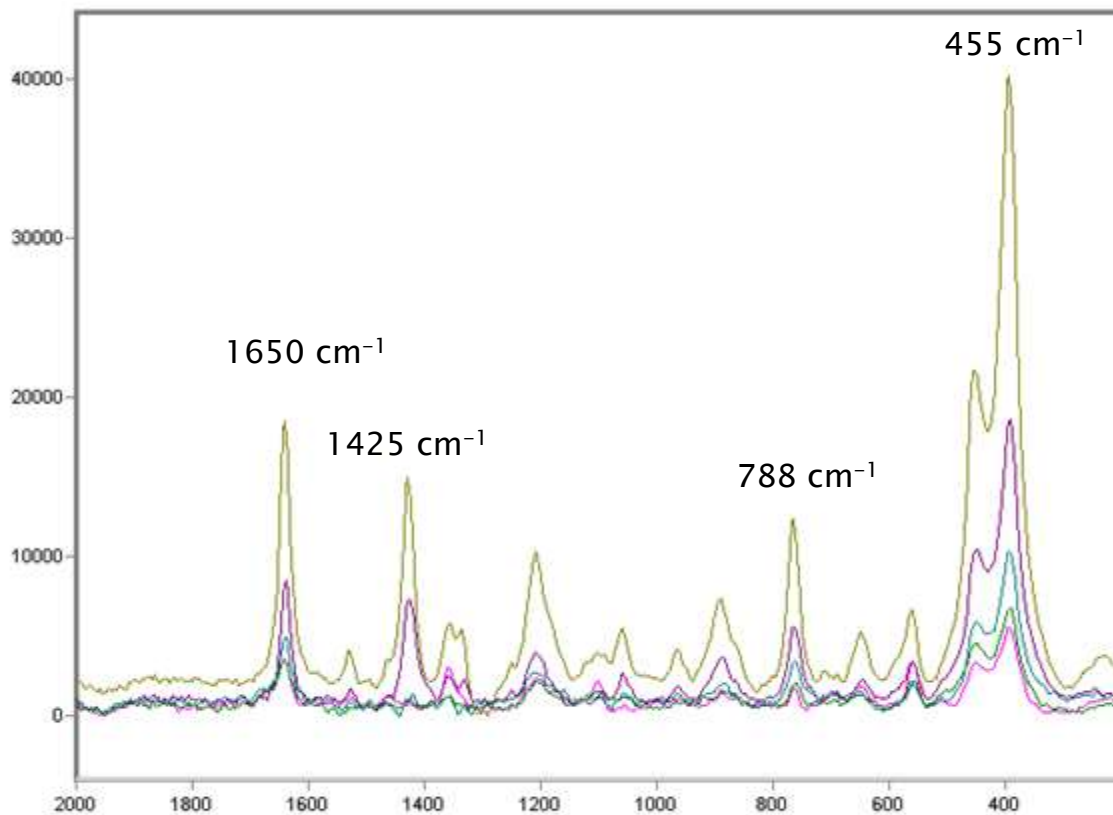
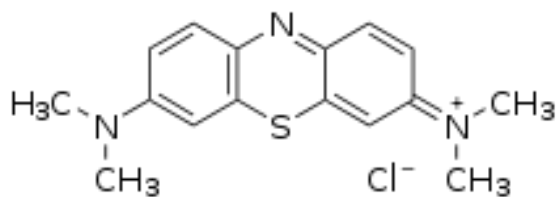
Intensity / Wavenumber (cm^{-1})

Overlay Z-Zoom CURSOR

Dye Library Methylene Blue

▶ Characteristic Peaks:

- 455 cm^{-1}
- 788 cm^{-1}
- 1425 cm^{-1}
- 1650 cm^{-1}



Intensity / Wavenumber (cm-1)

Overlay Z-Zoom CURSOR

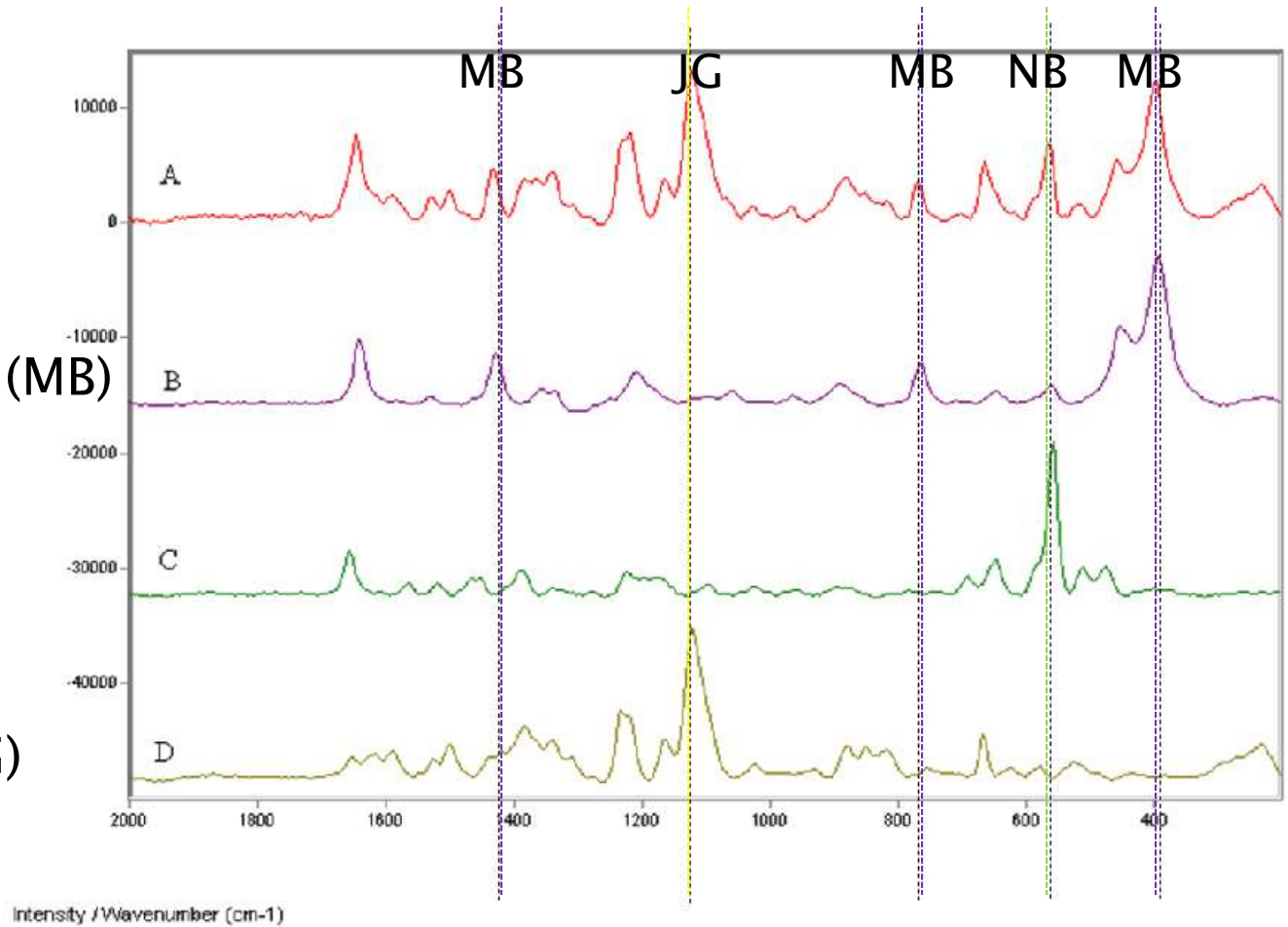
1st Multiplex: 3 dyes

A. Multiplex

B. Methylene Blue (MB)

C. Nile Blue (NB)

D. Janus Green (JG)



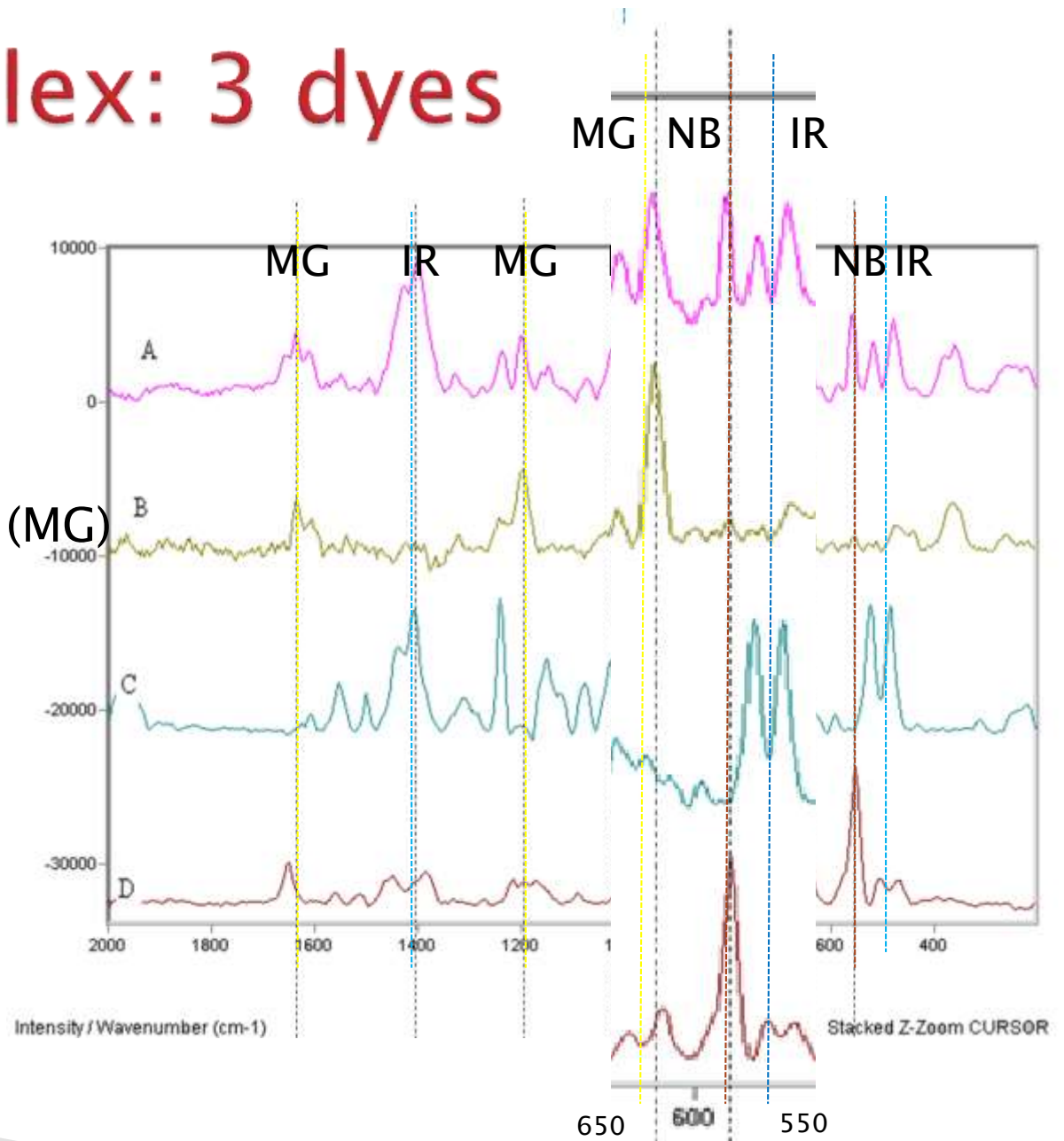
2nd Multiplex: 3 dyes

A. Multiplex

B. Malachite Green-ITC (MG)

C. IR-792 (IR)

D. Nile Blue (NB)



3rd Multiplex: 4 dyes

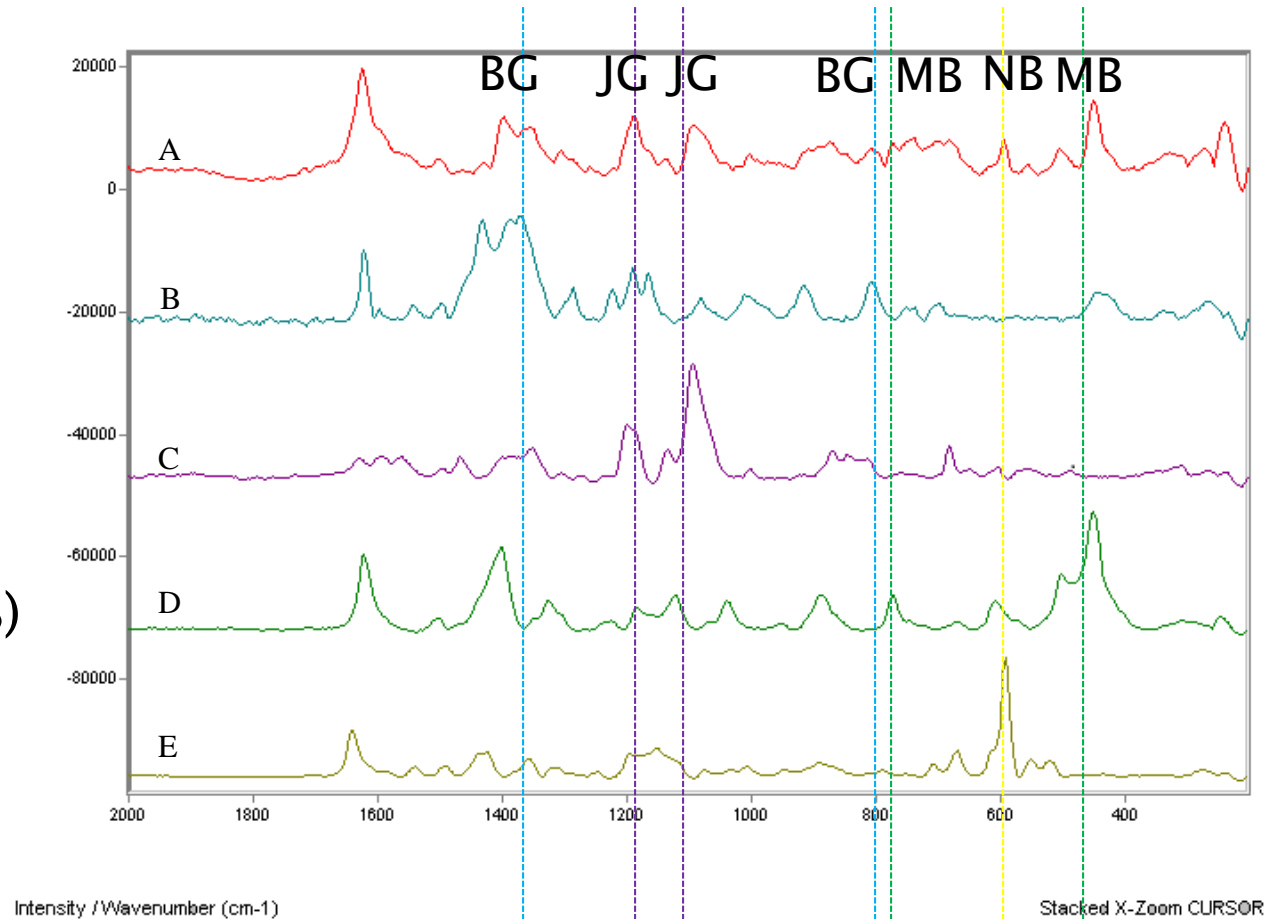
A. Multiplex

B. Brilliant Green (BG)

C. Janus Green (JG)

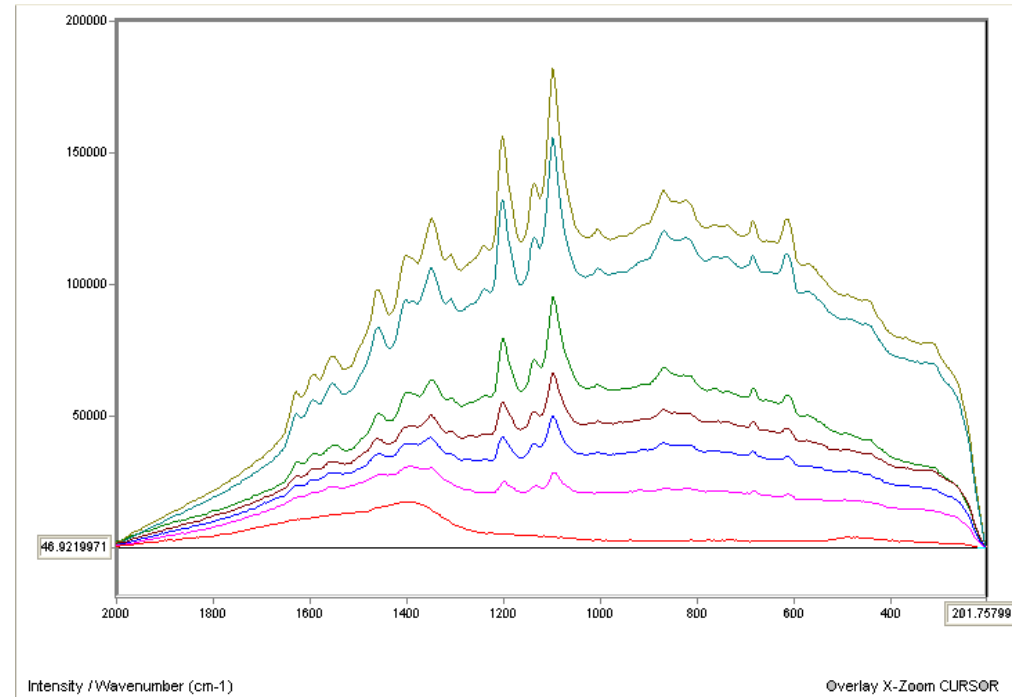
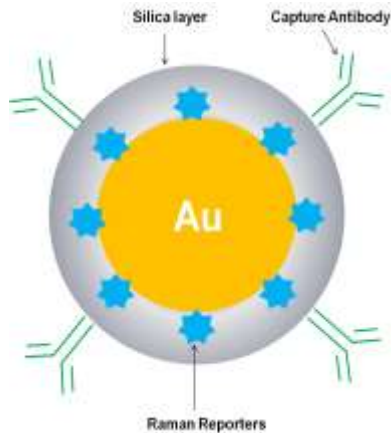
D. Methylene Blue (MB)

E. Nile Blue (NB)



Silica Coated Nanoparticles

- ▶ Janus Green silica coated nanoparticles
- ▶ Capable of detection for 7 days



Conclusions

- ▶ Successful dye library for 20+ dyes
 - Concentration range 1 mM to 1 pM
 - Characteristic peaks identified
- ▶ Successful multiplexing
 - 3 dye combination
 - 4 dye combination
- ▶ Silica covered nanoparticles
 - 1 stable dye

What's Next?

- ▶ Quantifying dilution series of dyes
- ▶ Multiplexing with silica encapsulated gold nanoparticles

Acknowledgements

- ▶ Dr. Patrick Johnson
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 - ▶ Kevin Schilling
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Questions?