

# **Nanoparticle Synthesis And Study of Catalytic Action**

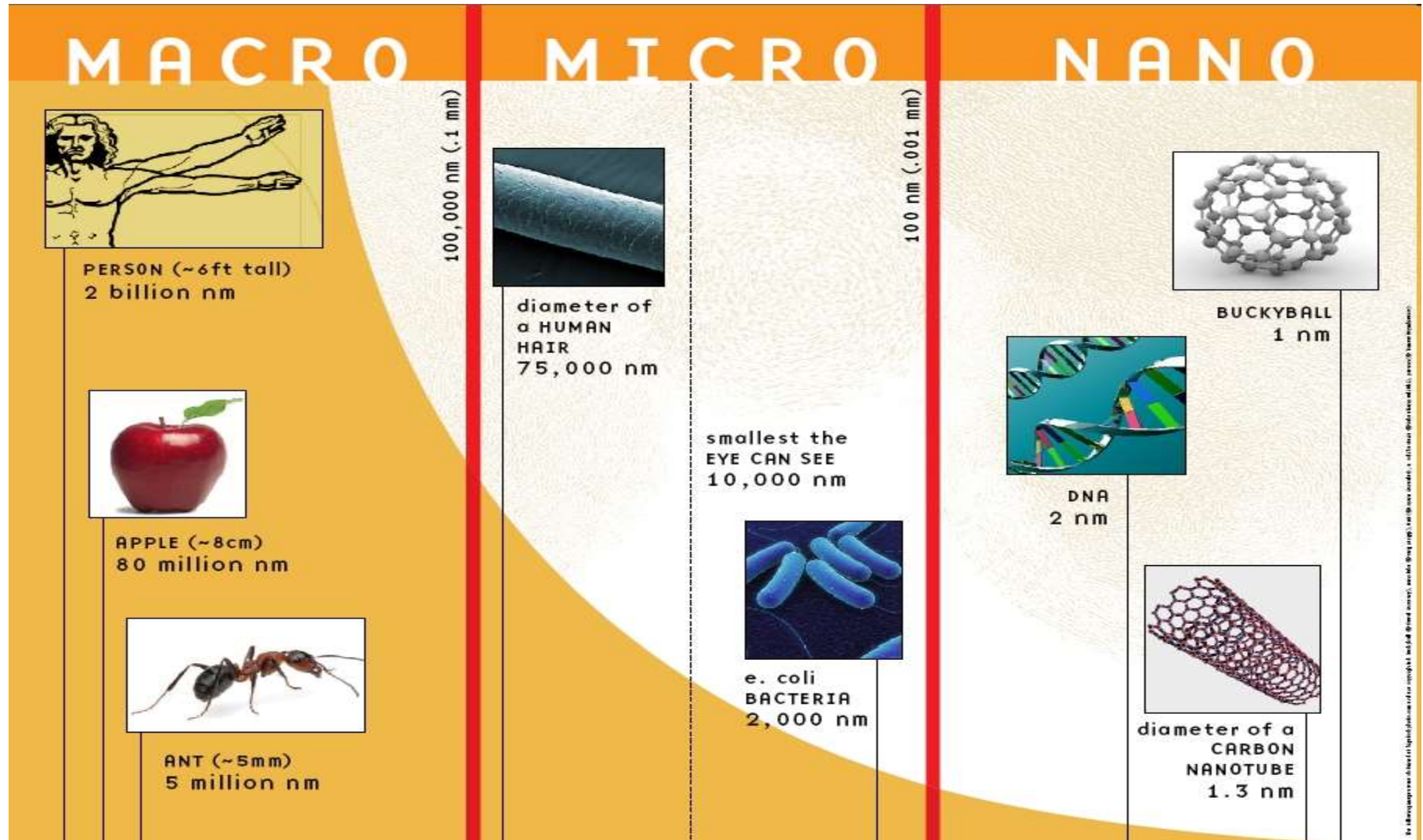
**By    Meghna Sheoran**

**Project under the guidance of  
Dr S. Venugopal  
Prof. S. K. Gupta.**



**Department of Chemical Engineering  
Indian Institute of Science  
Bangalore.**

# What is nanotechnology ?

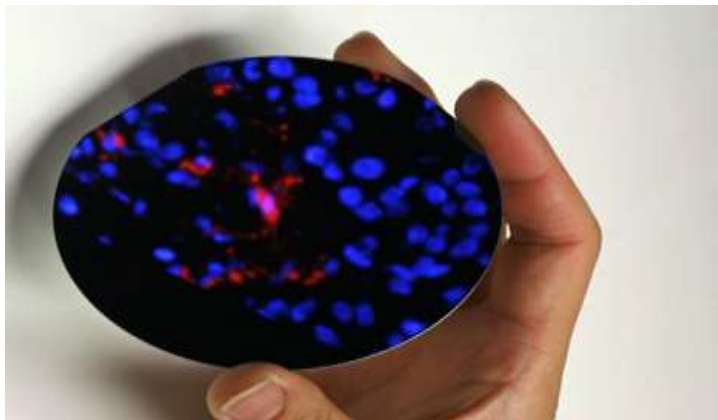
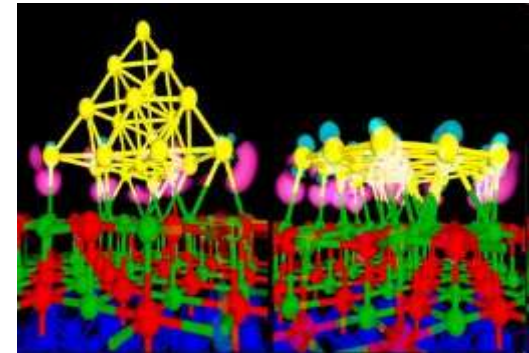
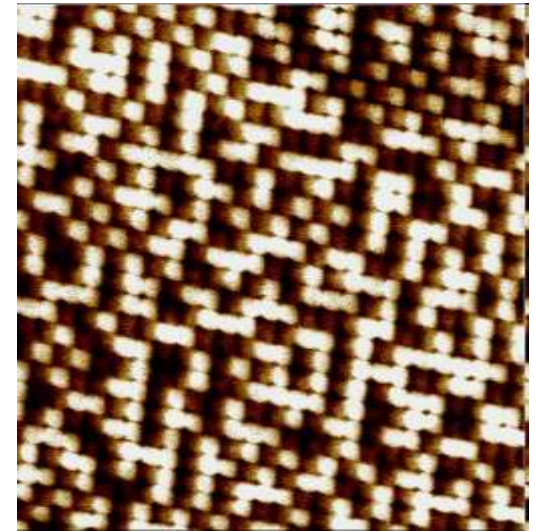


# Why Nanotechnology ?

- **Bridge between atoms and bulk solids.**
- **Interesting properties on nanoscale.**
- **Electron confinement manipulates properties.**
- **Different shapes as nanorods, nanoprisms, nanowires.**

# Applications:

- Drug Delivery
- Bioanalysis
- Cancer-tissue imaging using dye-doped nanoparticles
- Catalysis
- Magnetic storage devices
- Dentistry



[www.medgadget.com/archives/img/43335ghi1.jpg](http://www.medgadget.com/archives/img/43335ghi1.jpg)  
[nanosingularity.wordpress.com/](http://nanosingularity.wordpress.com/)

[www.physorg.com/Researchers](http://www.physorg.com/Researchers) find controls to gold nanocatalysis

# NanoTechnology Industry Focus

technolytics

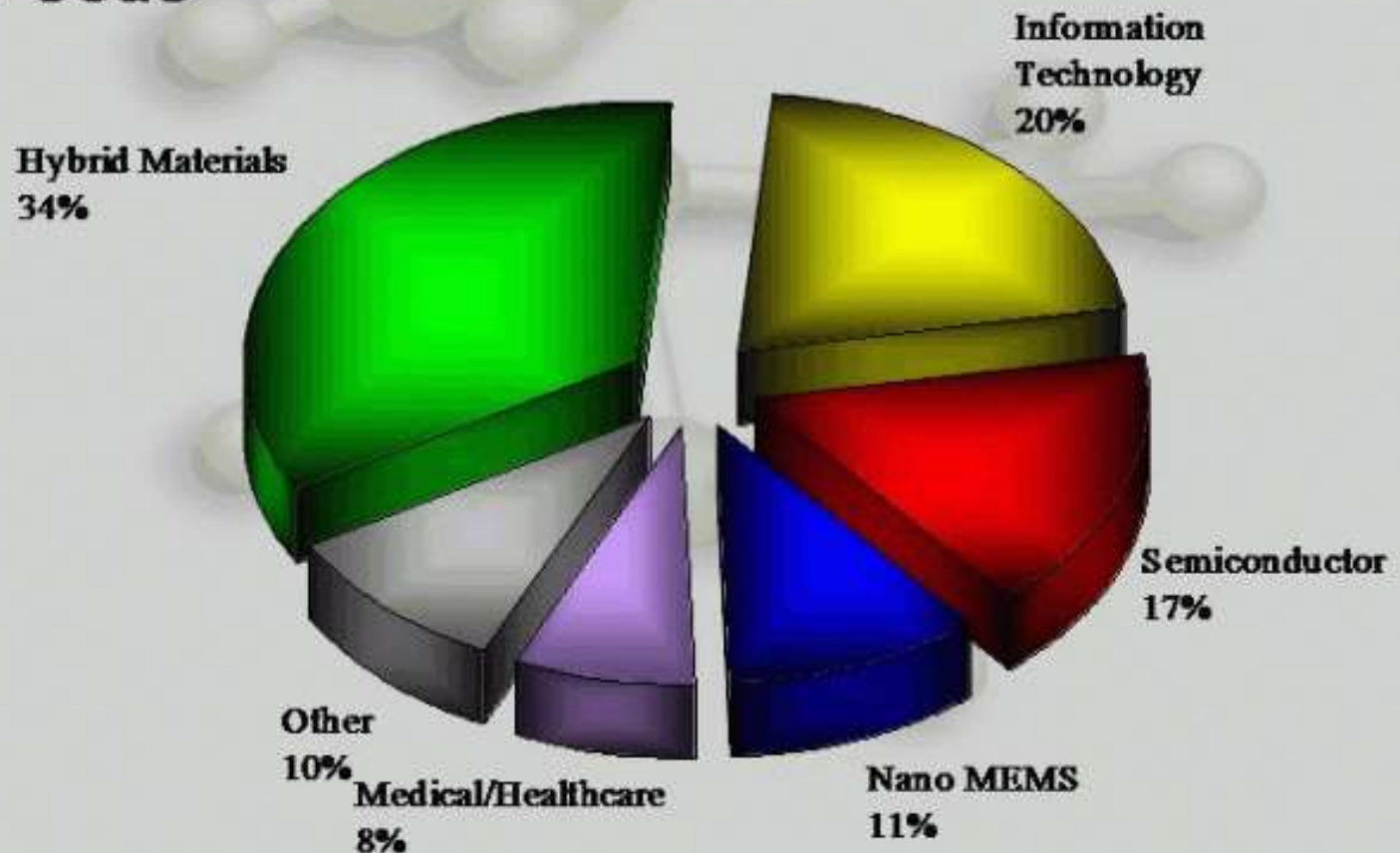


Figure 4

[http://www.directionsmag.com/images/articles/nano\\_tech/na](http://www.directionsmag.com/images/articles/nano_tech/na)  
no0.gif



# Synthesis of nanoparticles.

## 1. Top- Down Approach:

**Start with bulk material and cut away material to make what you want. characterised by low energy efficiency and high polydispersity. Contamination of crystals also a problem.**



## 2. Bottom- Up Approach:

**Building what you want by assembling it from building blocks (such as atoms and molecules). Produce particles with low contamination levels.**



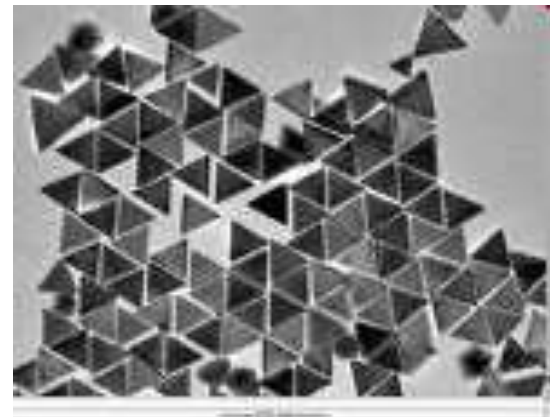
Bottom-Up approach may be

1. Gas-Phase Synthesis
2. Liquid-Phase Synthesis

Liquid-Phase synthesis is most widely used as it require less energy.

# Objective

**Approach is towards looking seeded growth of gold-platinum bimetallic nanoplates and then study the catalytic activity of thus obtained Au/Pt Bimetallic nanoplates using liquid-phase synthesis**



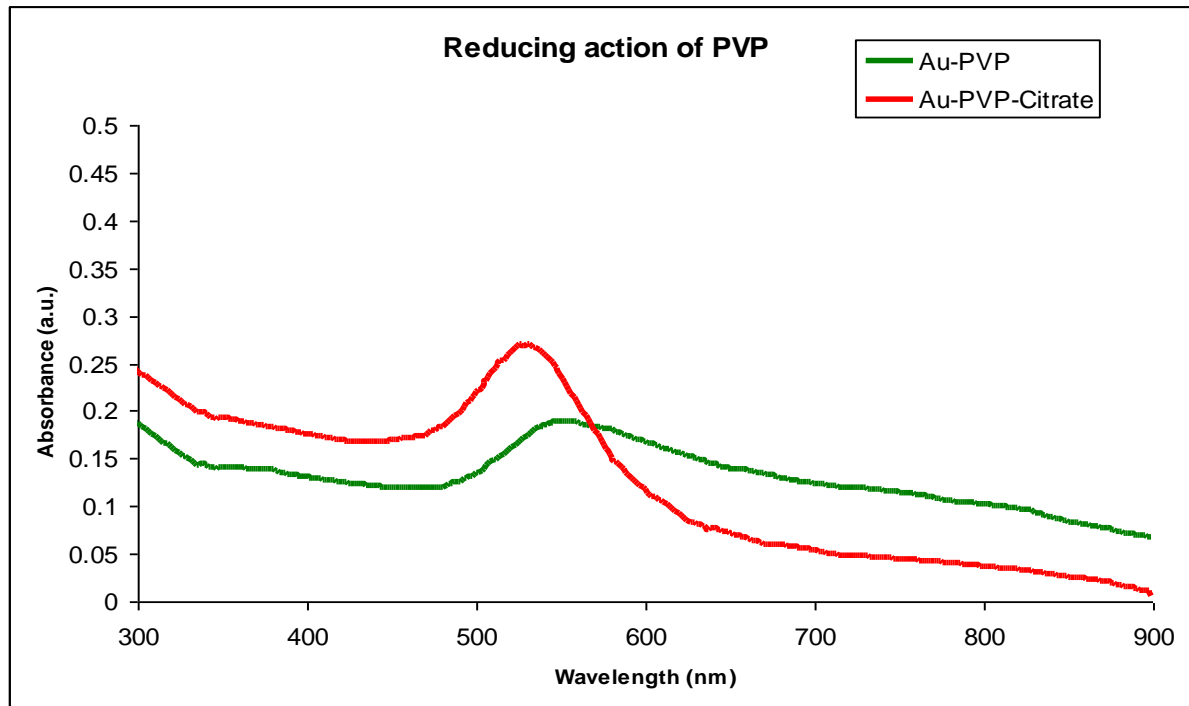
## Why nanoplates?

**Because catalytic activity is shape-dependent as for nanoparticles of different shapes, but of same size, the larger the percentage of edge and corner atoms, the more catalytically active it is.**



# Synthesis of nanoplates

- Results produced by Seong and coworkers not reproducible
- PVP which was supposed to have stabilising action was also reducing.

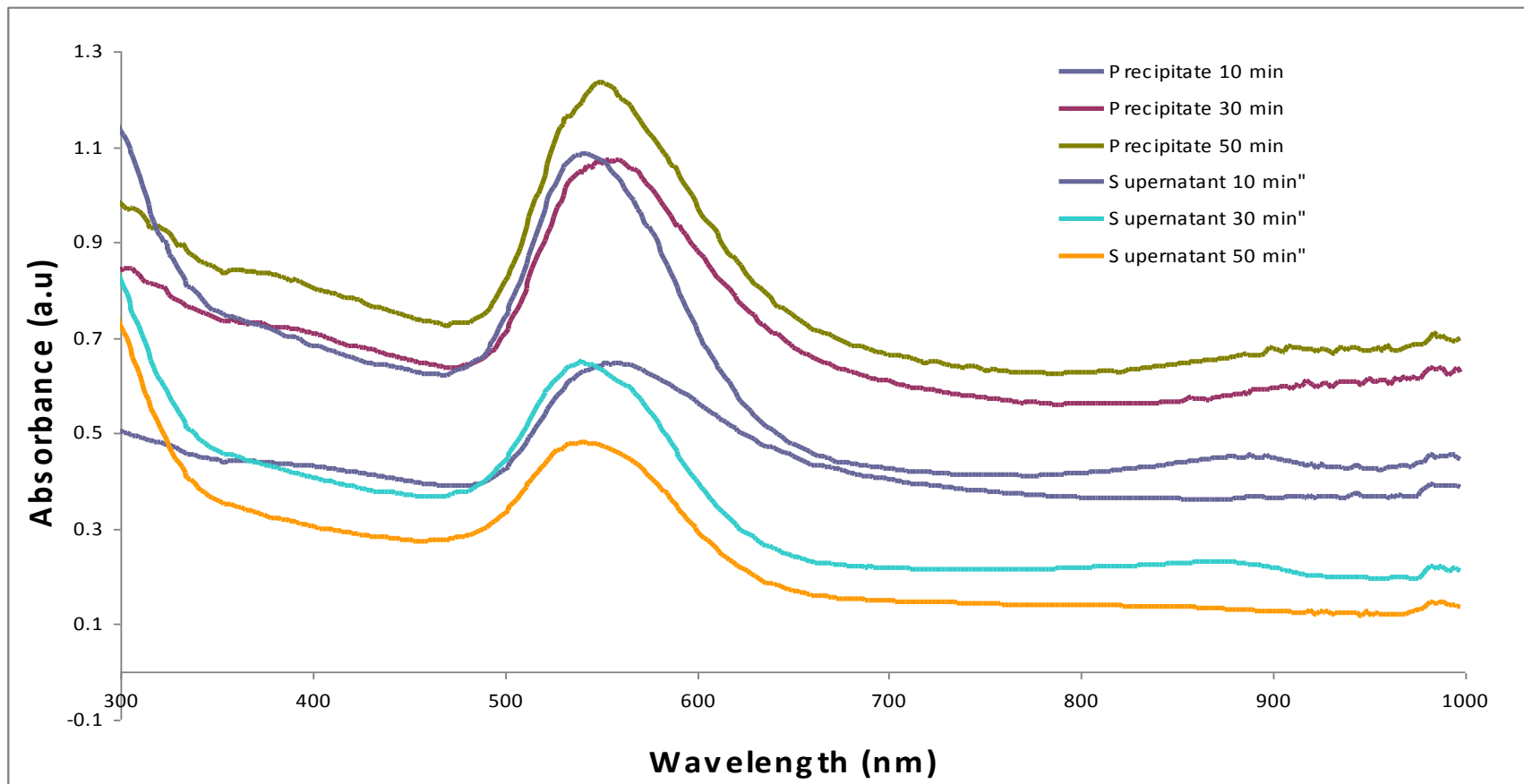


# **Separation of nanoplates:**

**The nanoparticles obtained are a mixture of nanospheres and Nanoplates and we are more interested in nanoplates than nanospheres so separation is required.**

**For the separation centrifuging technique was used.**

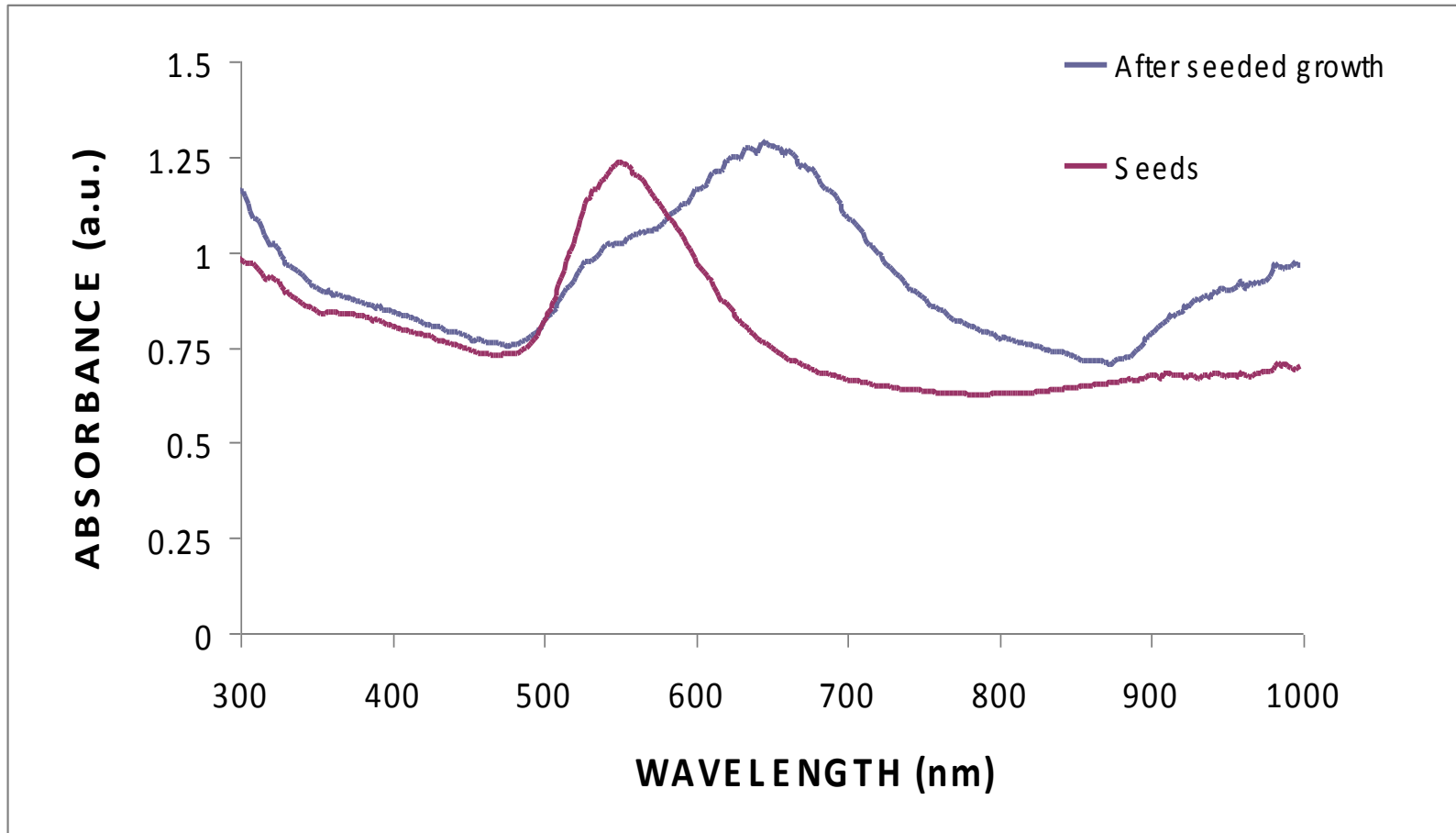
# Separation of nanoplates by centrifuging (PVP+Citrate Method)



**Best results on centrifuging for 50 min.  
Nanoplates settled and were recovered in precipitate.**

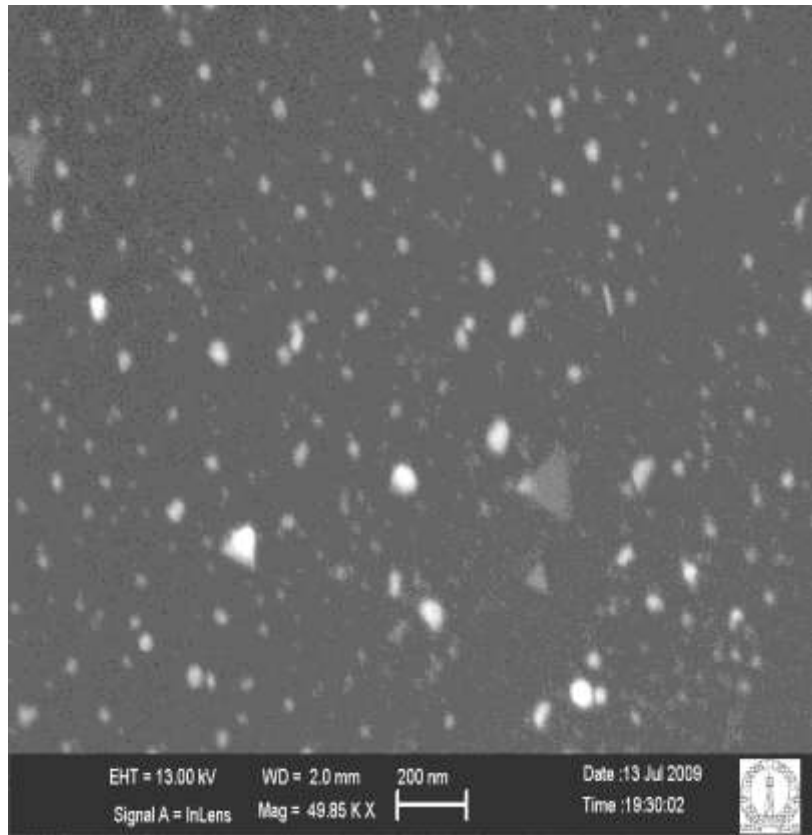
# Seeded Growth of Gold nanoplates (PVP+Citrate Method)

This was done to check whether gold is depositing on gold or not.

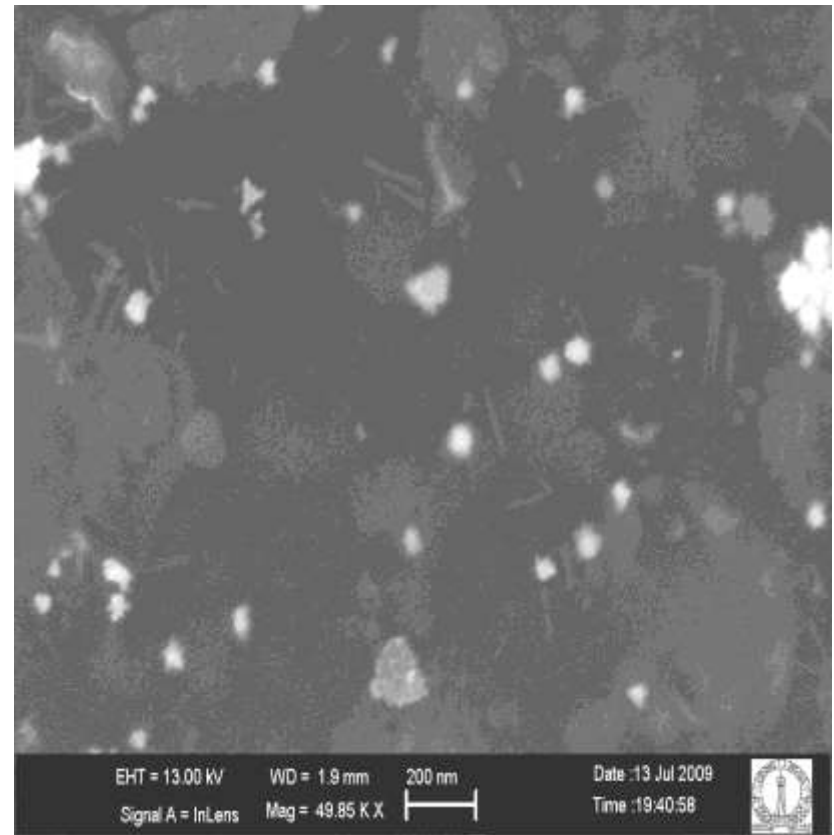


Slight shift in peak shows seeded growth is taking place.

# SEM image :



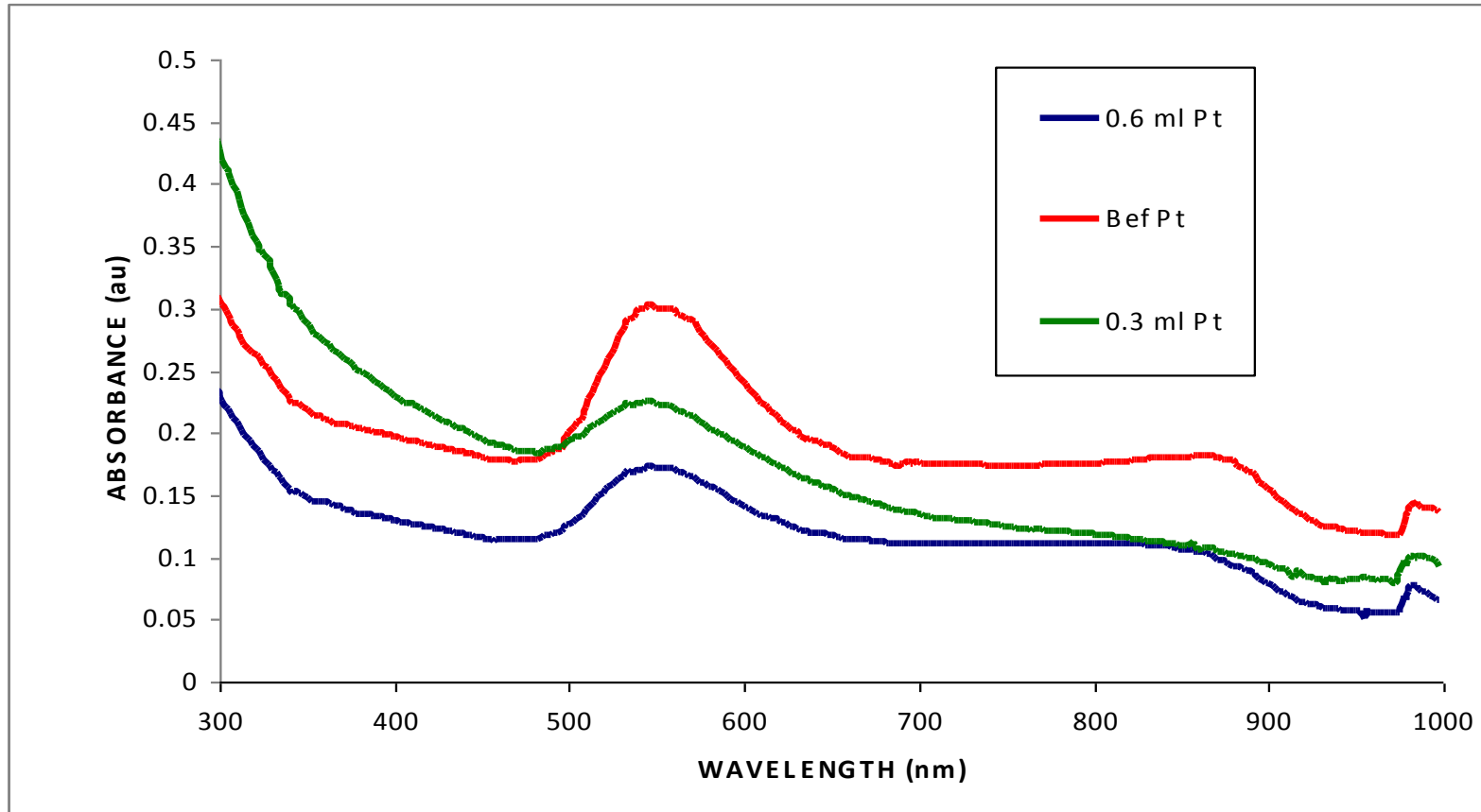
SEM image of seed



SEM image of seeded gold

# Platinum coated gold nanoplates

This was done to check whether it is possible to get Au/Pt bimetallic nanoplates using this method.

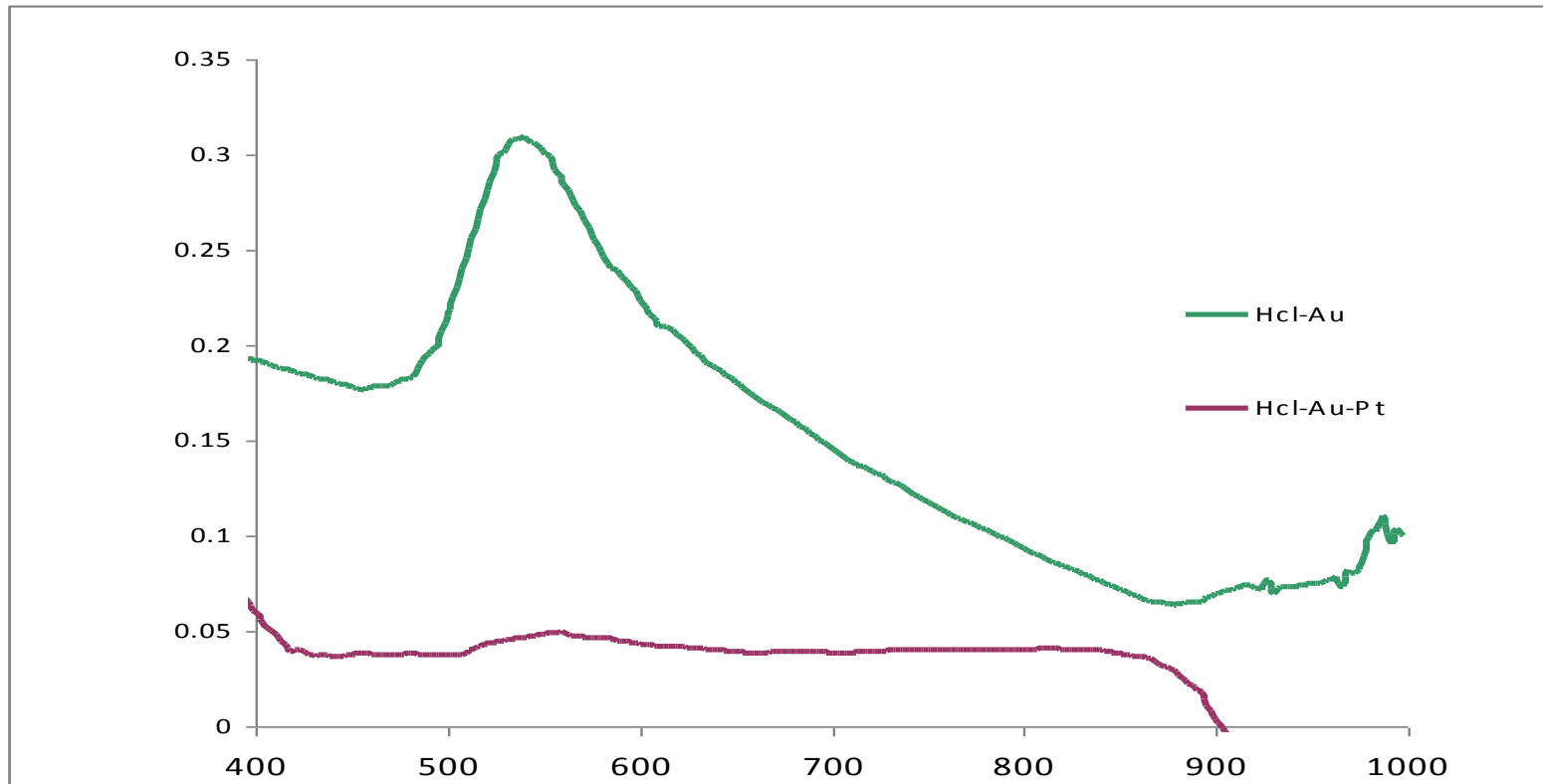


As the peak is likely to flatten with addition of Platinum it can be predicted that platinum is plating on gold.



# Synthesis of nanoplates using (HCl+Citrate Method):

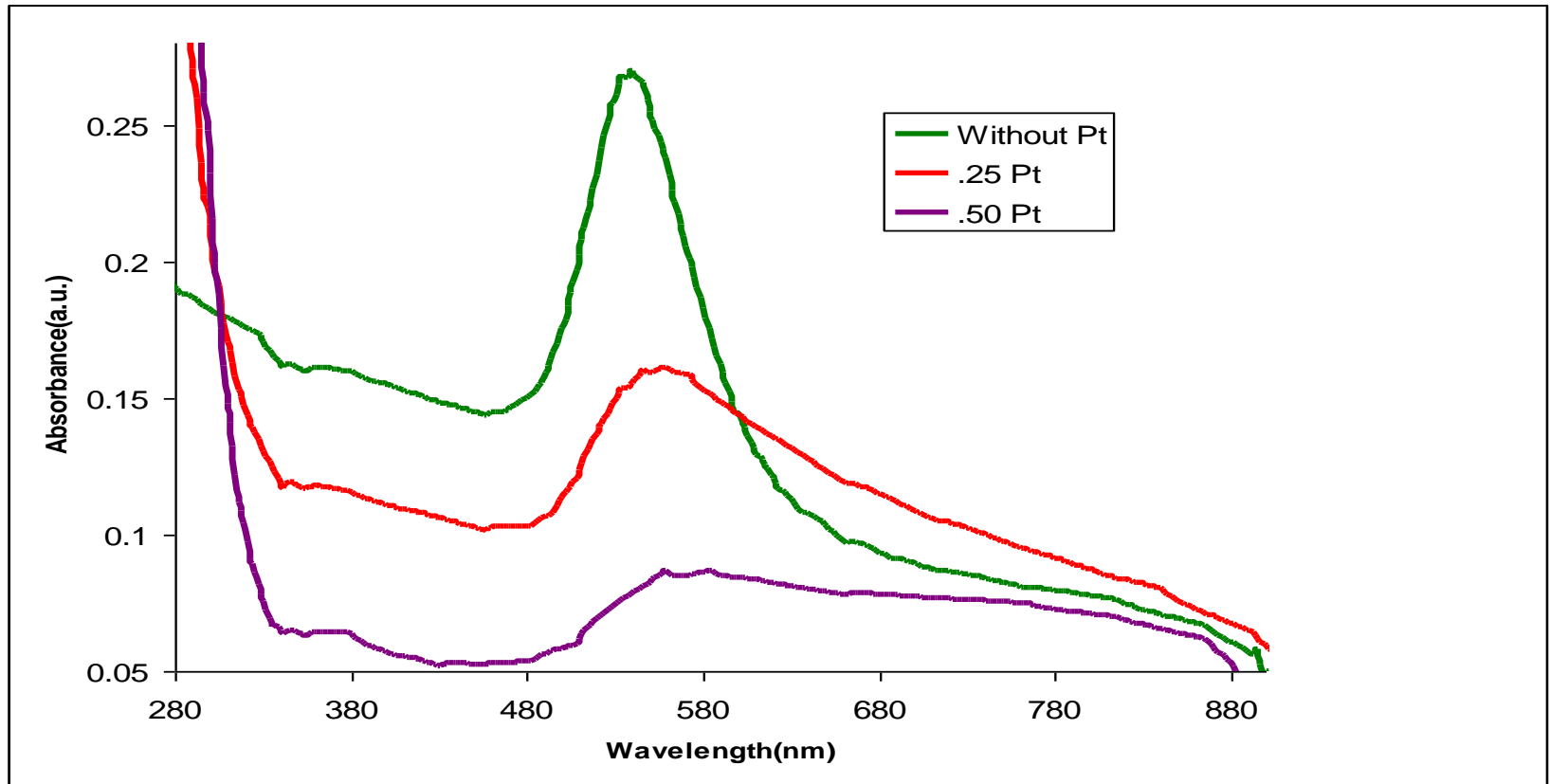
- Reaction was done using HCl but the particles crashed.
- Then to maintain the pH,  $K_2CO_3$  was used



As the peak has flattened and the absorbance is very low in 800-900 nm range, it means nanoplates are forming and Also platinum is plating.

# Experiment to determine appropriate amount of Platinum to be added: (a) 25% Pt

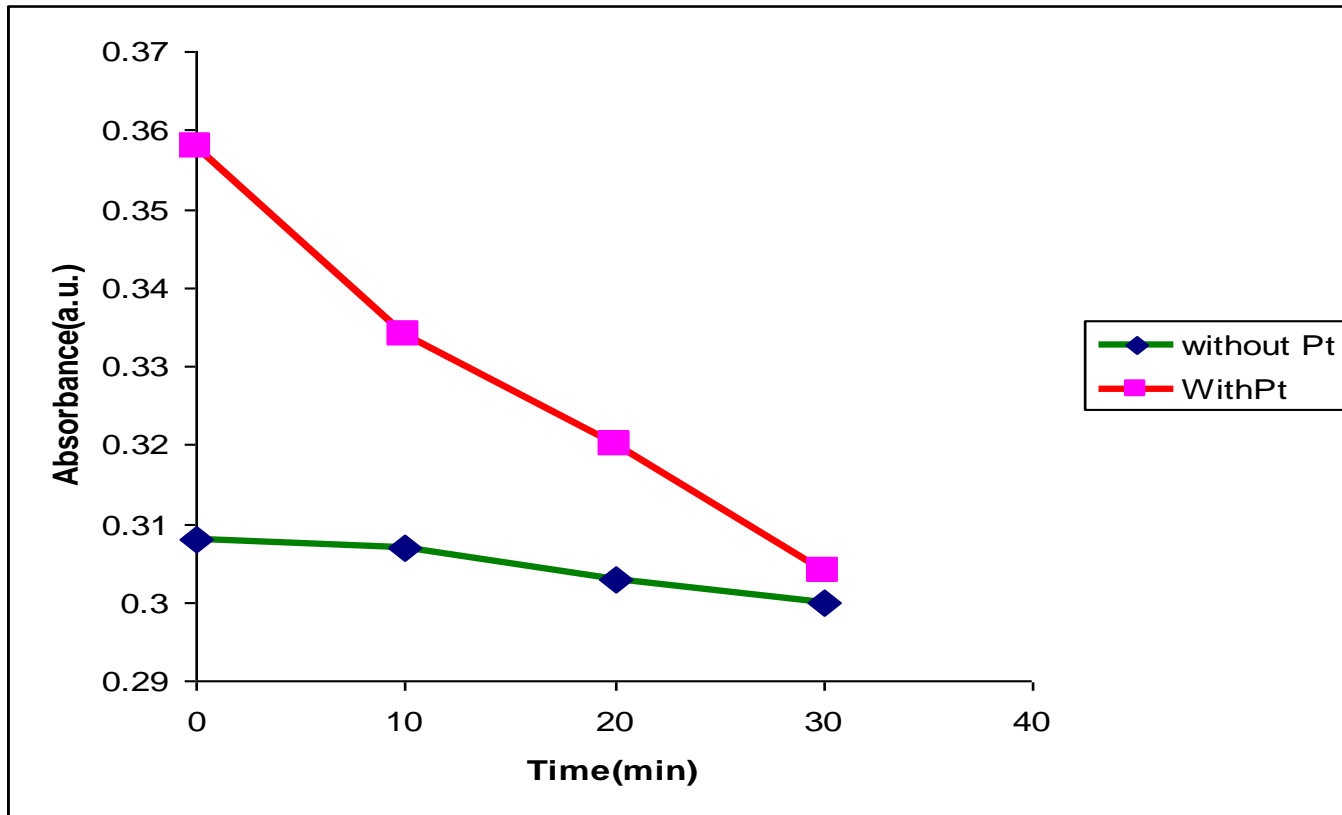
(b) 50% Pt



▪50% Pt gives better results.

# Catalytic Activity of Au/Pt nanoplates

- Reaction of thiosulphate and ferrocyanide done with and without Au/Pt nanoplates.
- Activation energy of reaction decreased with Au/Pt nanoplates.



# **Conclusions**

**Nanoplates provides catalytic action.**

## **Future Work**

- Which is better: Nanospheres or nanoplates.**
- Factor responsible for catalytic action: surface/volume ratio or particles on edge and corners**

The background is a vibrant autumn scene. A light-colored path winds from the bottom left towards the center. On either side of the path are five trees with brown trunks and large, glowing orange circular canopies. Small orange leaves are scattered on the ground around the trees. The sky is a deep blue, filled with three white, fluffy clouds. Radiating from behind the central cloud are numerous thin, light blue lines that spread across the sky, creating a sunburst effect.

**Thank You**