

# Carbon-Metal composite as Electrocatalyst in electrochemical sensors

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## **INTRODUCTION:**

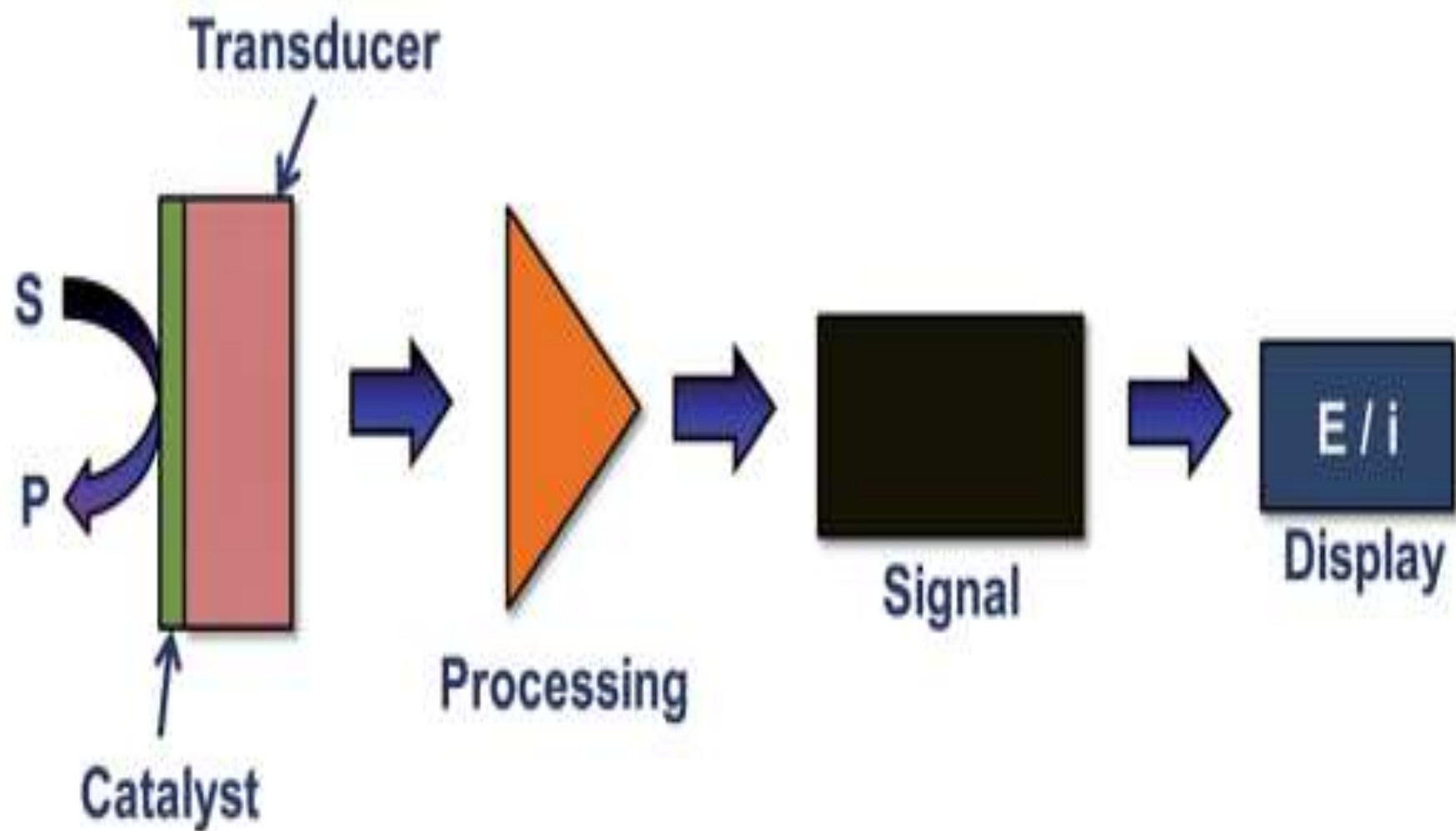
### **Sensor:**

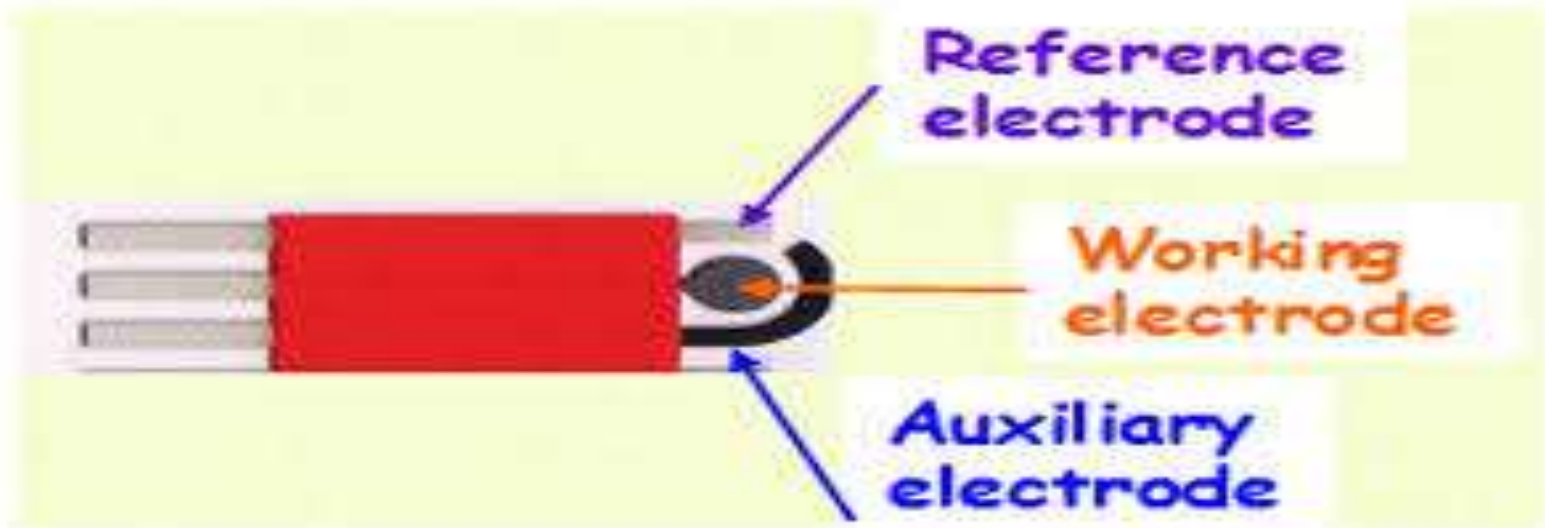
A small device used for direct measurement of a physical quantity of an analyte in a sample.

- Response is continuous and reversible

### **Electrochemical Sensor:**

- Produces an electrical signal that is related to the concentration of an analyte.





## Screen printed electrochemical sensor

The basic components of an electrochemical sensor are a working (or sensing) electrode, a counter electrode and usually a reference electrode as well.



**Glucose monitoring in body by screen printed electrochemical sensor**

## **There are three main types of electrochemical sensors:**

### **01) potentiometric:**

Measure the potential at working electrode when zero or negligible current flow between them.

### **02) Amperometric :**

They measure the change in current produced, as a result of chemical reaction between electroactive materials, when a constant potential is applied between the electrodes.

### **03) Conductometric:**

They measure change in conductivity of analyte solution between the electrodes.

# Carbon-Metal Nanocomposite

It consists of:

- ✓ Metal (nanoparticles)
- ✓ Carbon as Support (usually graphene, CNT,...)



# Why Nanoparticles

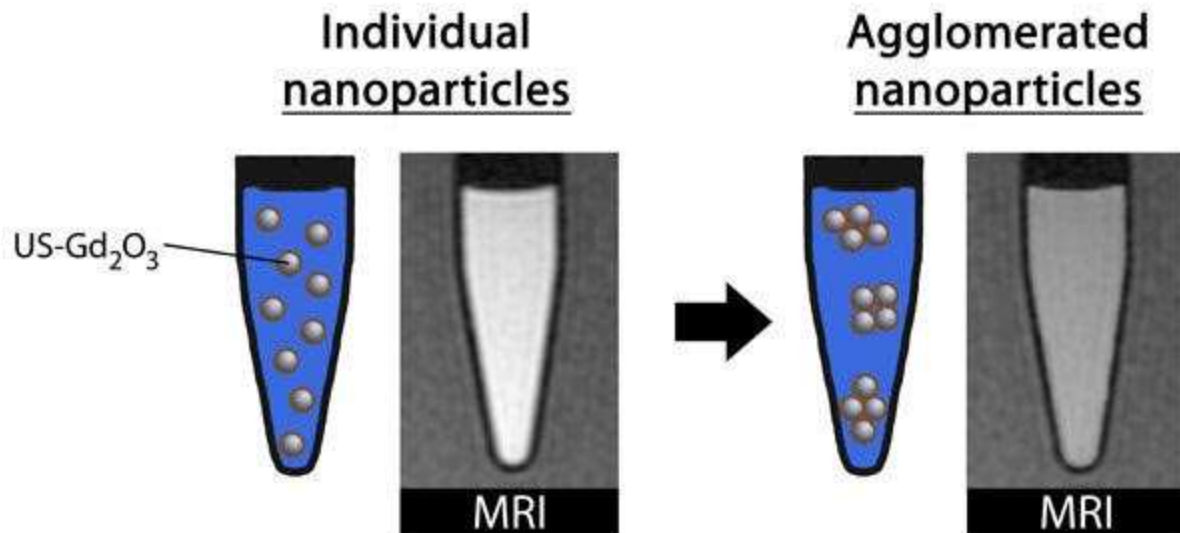
- The unique chemical and physical properties of nanoparticles make them extremely suitable for designing new and improved sensing devices, especially electrochemical sensors and biosensors
- Many kinds of nanoparticles, such as metal, oxide and semiconductor nanoparticles have been used for constructing electrochemical sensors and biosensors.
- Very high Specific surface area.

## The Functions of nanoparticles:

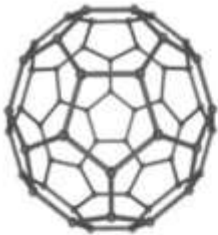
- Immobilization of biomolecules
- Catalysis of electro-chemical reactions
- Enhancement of electron transfer

# Problem of Nanoparticles

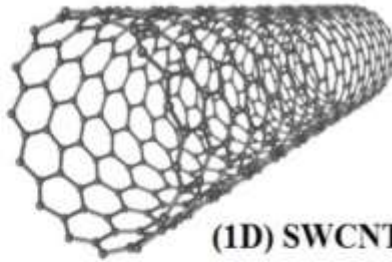
Agglomeration:



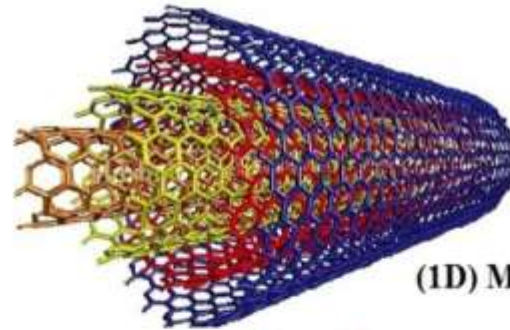
# Carbon



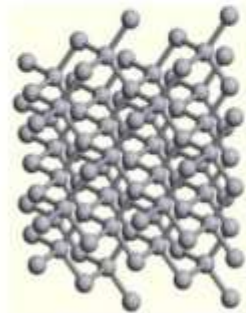
**(0D) Fullerene**



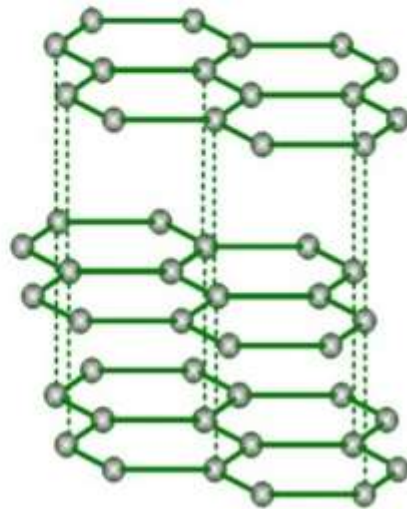
**(1D) SWCNT**



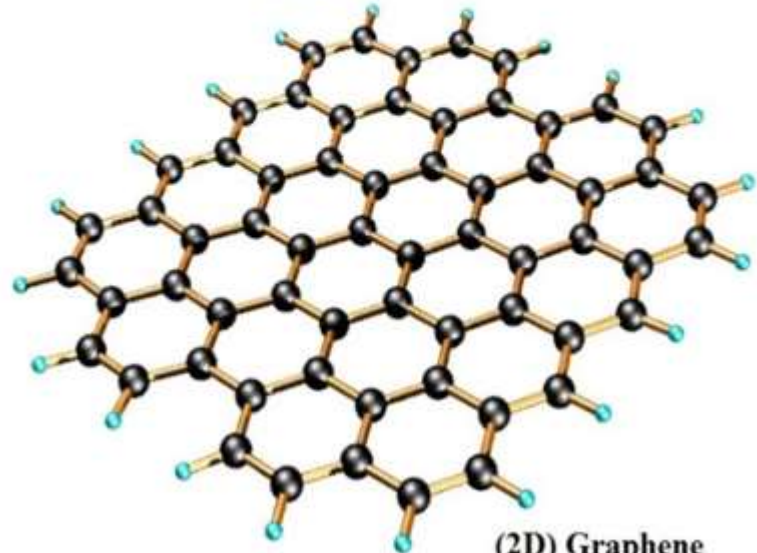
**(1D) MWCNT**



**(3D) Diamond**



**(3D) Graphite**



**(2D) Graphene**

# Properties which make graphene useful in sensor:

- ❖ Large surface to volume ratio
- ❖ High electron mobility
- ❖ Good chemical stability
- ❖ Unique optical properties, excellent electrical conductivity
- ❖ Exceptional thermal conductivity (5000W/m/K)
- ❖ Extremely light weight
- ❖ Very low resistivity

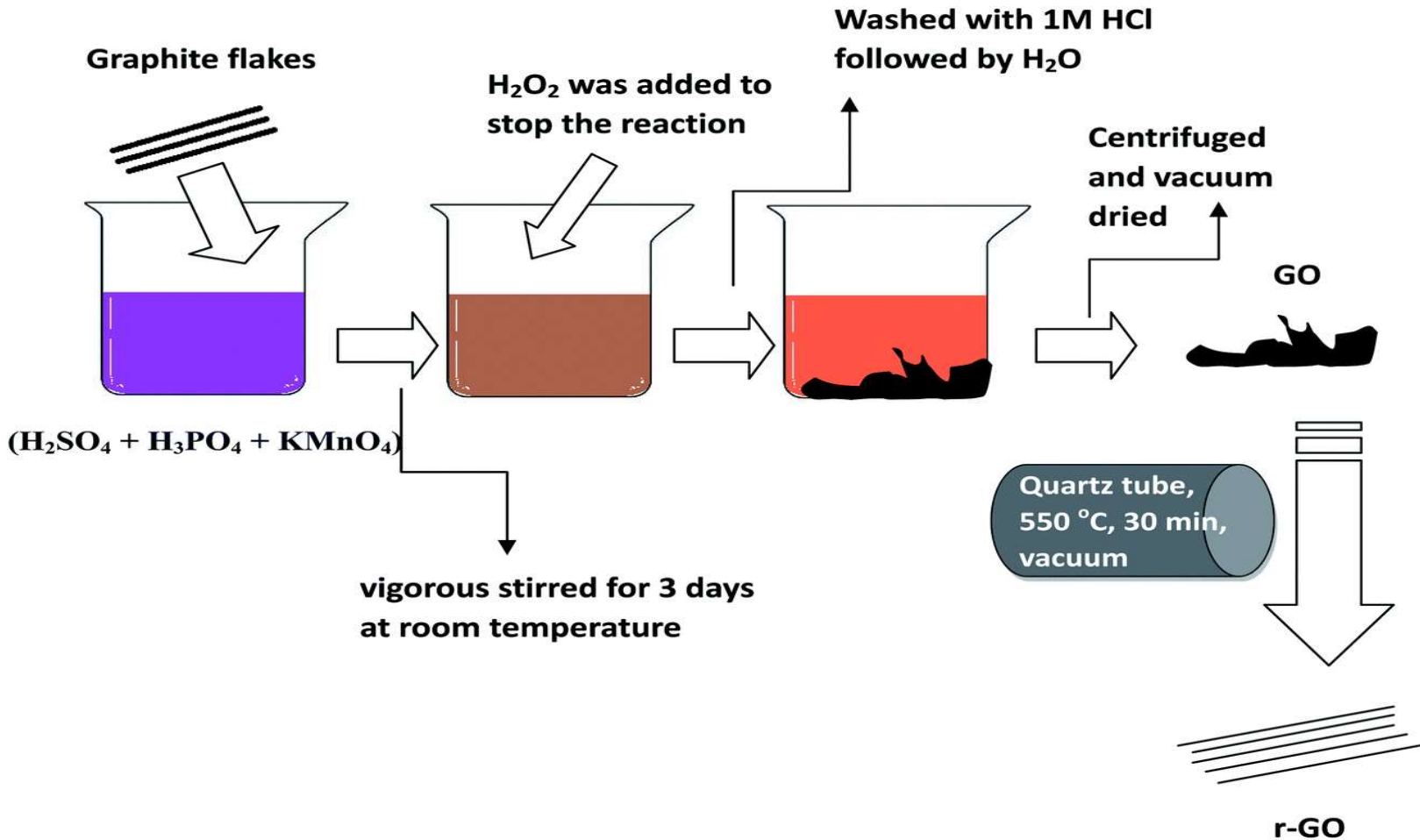
# Preparation:

## Graphene:

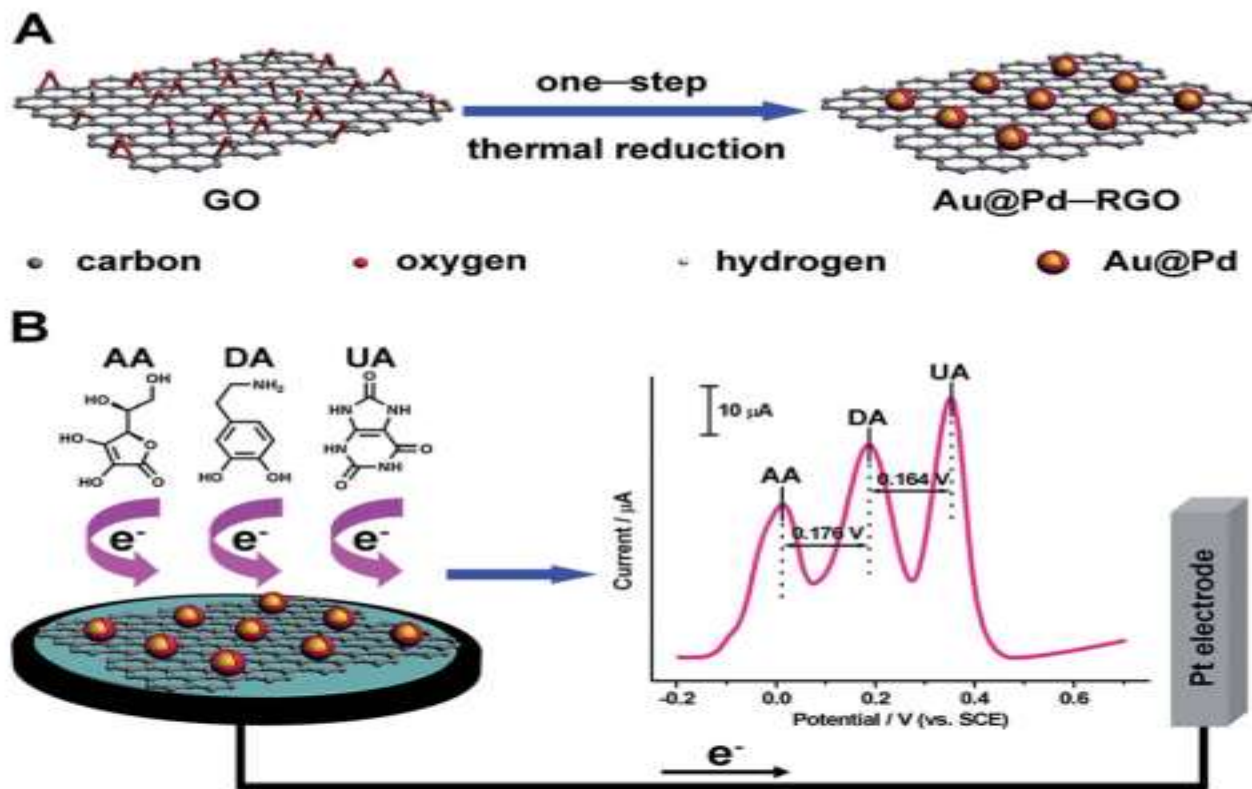
- Liquid exfoliation of graphite
- Chemical Vapour Deposition
- Hummers Method

These methods generally involve the oxidation of graphite to graphite oxide, the subsequent exfoliation to graphene oxide (GO) and the final reduction to reduced graphene oxide (rGO).

# Preparation of Graphene



# Preparation of nanocomposite



Scheme 1 Illustration of preparations of (A) Au@Pd-RGO nanocomposites and (B) Au@Pd-RGO/GCE sensors for simultaneous determination of AA, DA, and UA.



# Conclusion

- Metal-Carbon Nanocomposites are made, not only to avoid agglomeration of nanoparticles but results in extraordinary sensing properties.

## References:

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- 5).Trogadas, P., Fuller, T.F., Strasser, P., Carbon as Catalyst and Support for Electrochemical Energy Conversion, Carbon (2014)



**Thank  
You!!!**