



# **“Click”able Amplified Fluorescent Polymers As Generic Platform for Next Generation of Chemical and biomedical Sensor**

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# Sensor Design

Signaling Event



Signal Transducer



Amplification



Storage and Display

# Conjugated Polymers

## *“Synthetic Metals”*

### *Electrical conductivity*

Conductivity approaching that of copper  
Chemical doping induces solubility  
**Transparent electrodes**, antistatics  
EMI shielding, conducting fibers

### *Control of electrochemical potential*

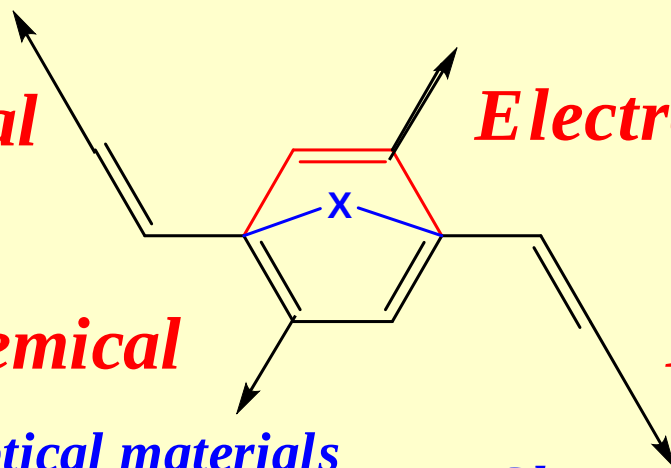
Electrochemical batteries  
Electrochromism and "Smart Windows"  
Light-emitting electrochemical cells

**Chemical**

**Electrochemical**

**Photochemical**

**Interfacial**



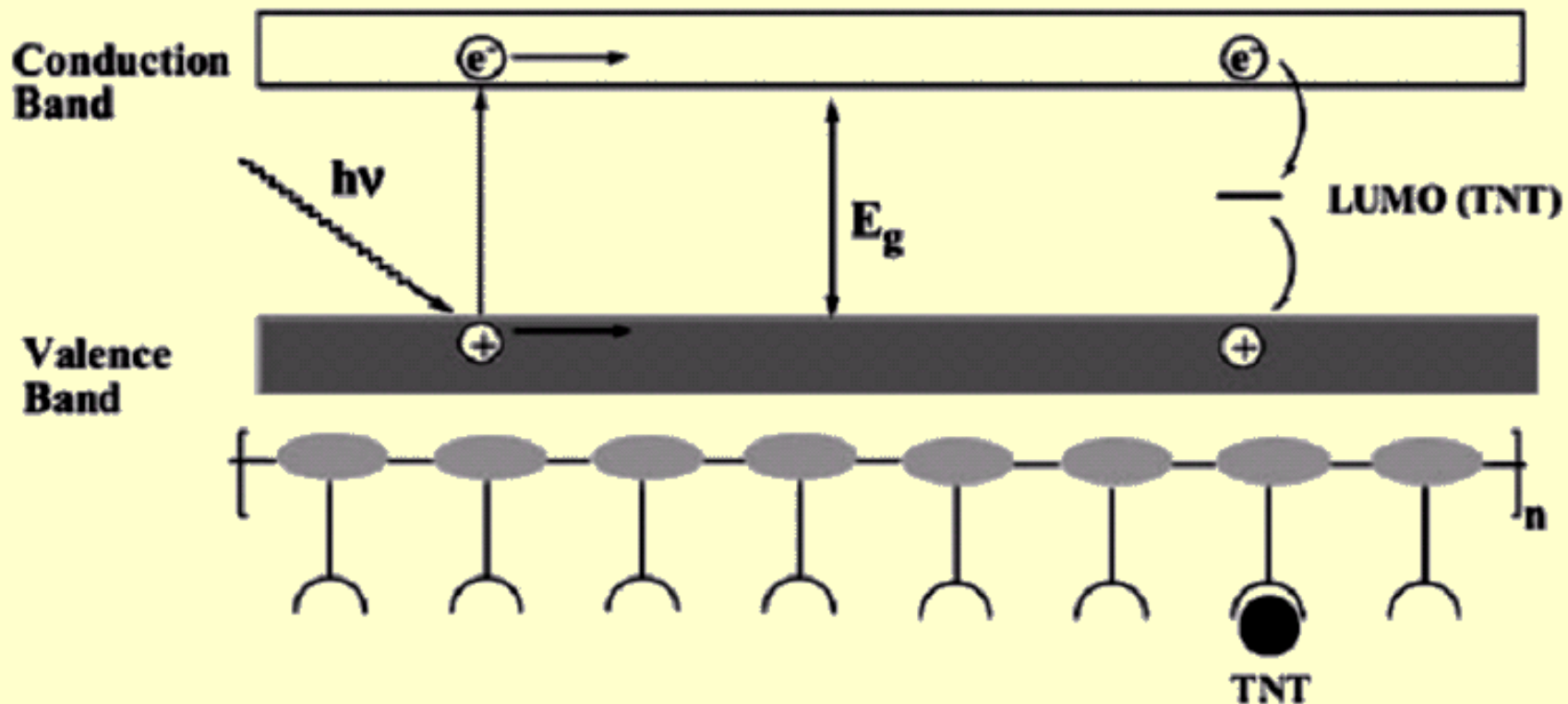
### *High-performance optical materials*

1-d Nonlinear optical phenomena  
Photoinduced electron transfer  
Photovoltaic devices  
Tunable NLO properties

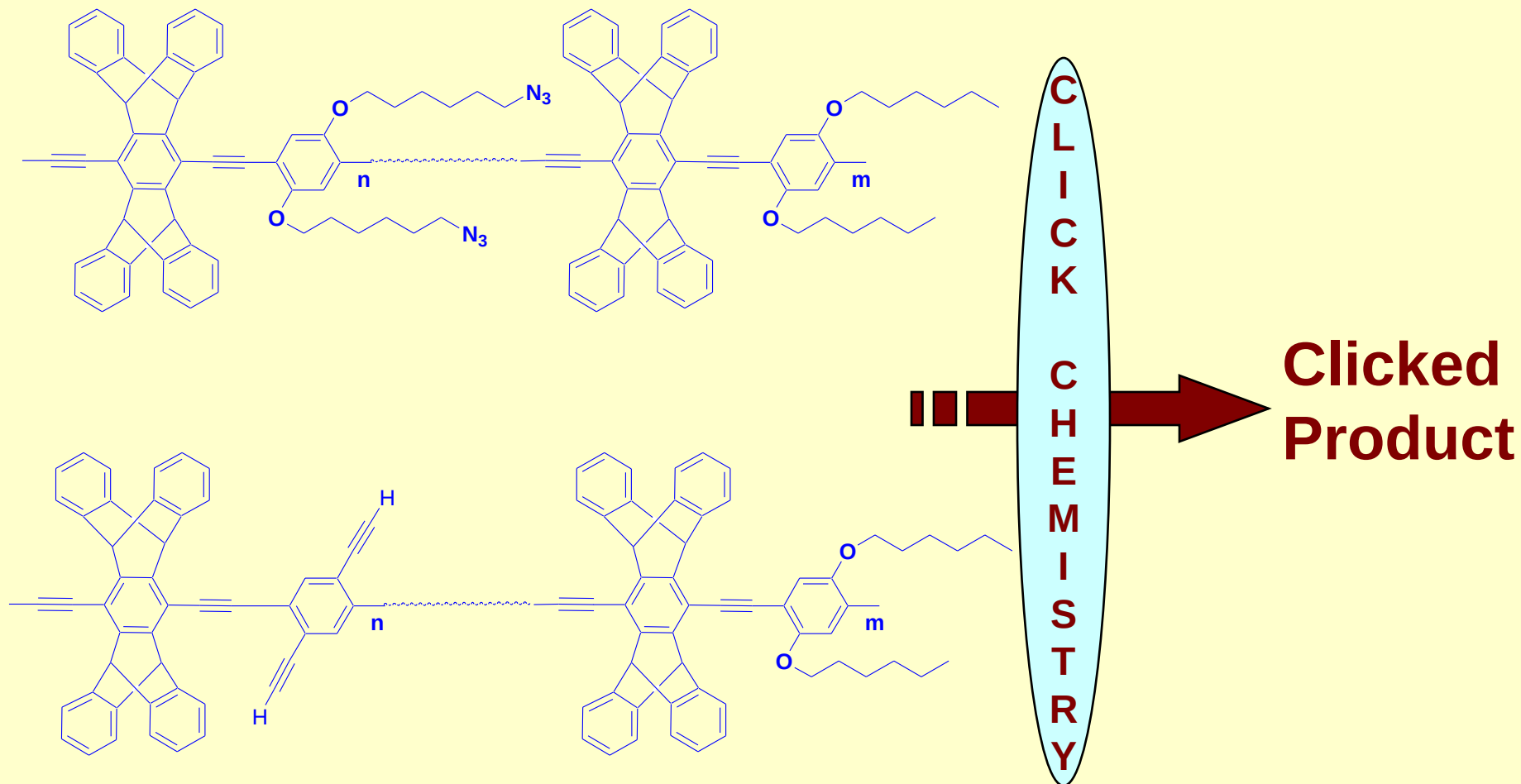
### *Charge injection without counterions*

Organic FET circuits  
Tunneling injection in LEDs

# Amplified Fluorescence Polymers



# “Click”able AFPs



“Functional Amplified Fluorescence Polymers” Jasmine Sinha, Anil Kumar, Phani Kumar Pullela;

Indian Patent File No. 2319/MUM/2008

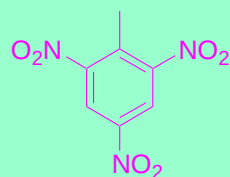


# **Amplified Fluorescent Polymers For Explosive Detection**

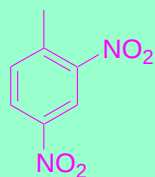


# Types of Explosives

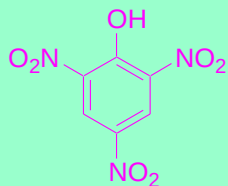
## Nitroaromatic



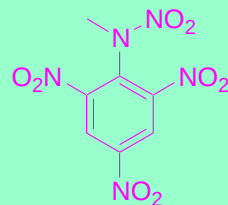
TNT



DNT

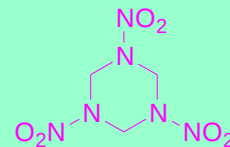


PA

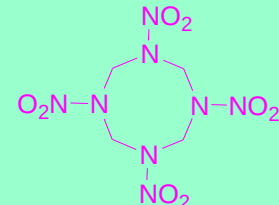


Tetryl

## Nitramine



RDX

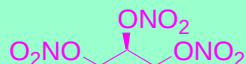


HMX

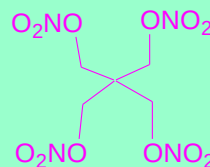
## Nitrate Ester



EGDN

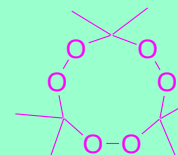


TNG

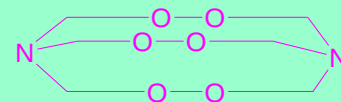


PETN

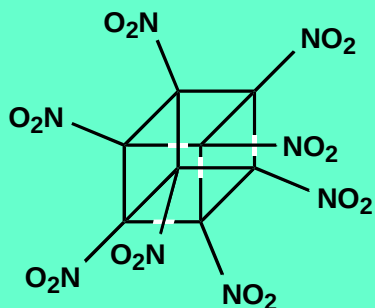
## Organic Peroxide



TATP



HMTD



Nitrate Ester

Vap. Press. (Torr):  $10^{-2}$ - $10^{-11}$

Detonation Velocity: 7-10k m/s

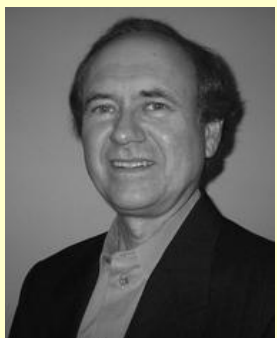
Speed of sound: 343 m/s

Speed of M16 Rifle: 975 m/s

# People Involved in Explosive Detection using Fluorescent Polymers



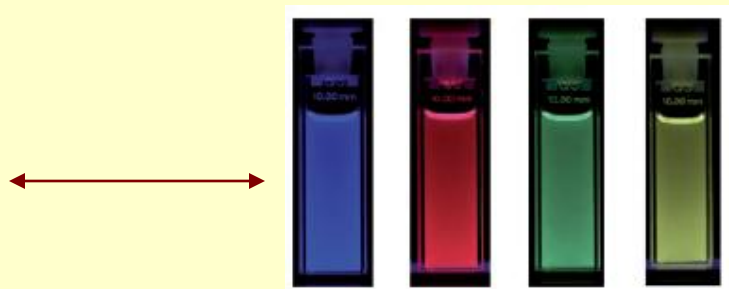
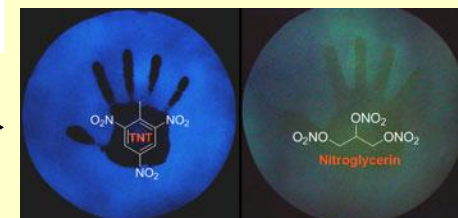
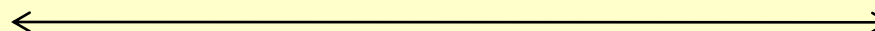
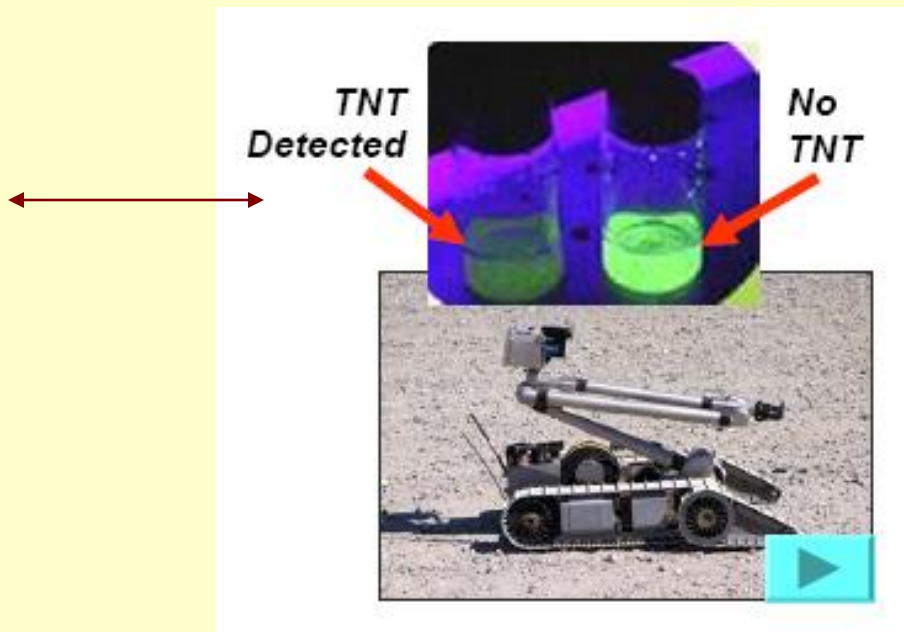
Timothy. M. Swager



William. C. Trogler

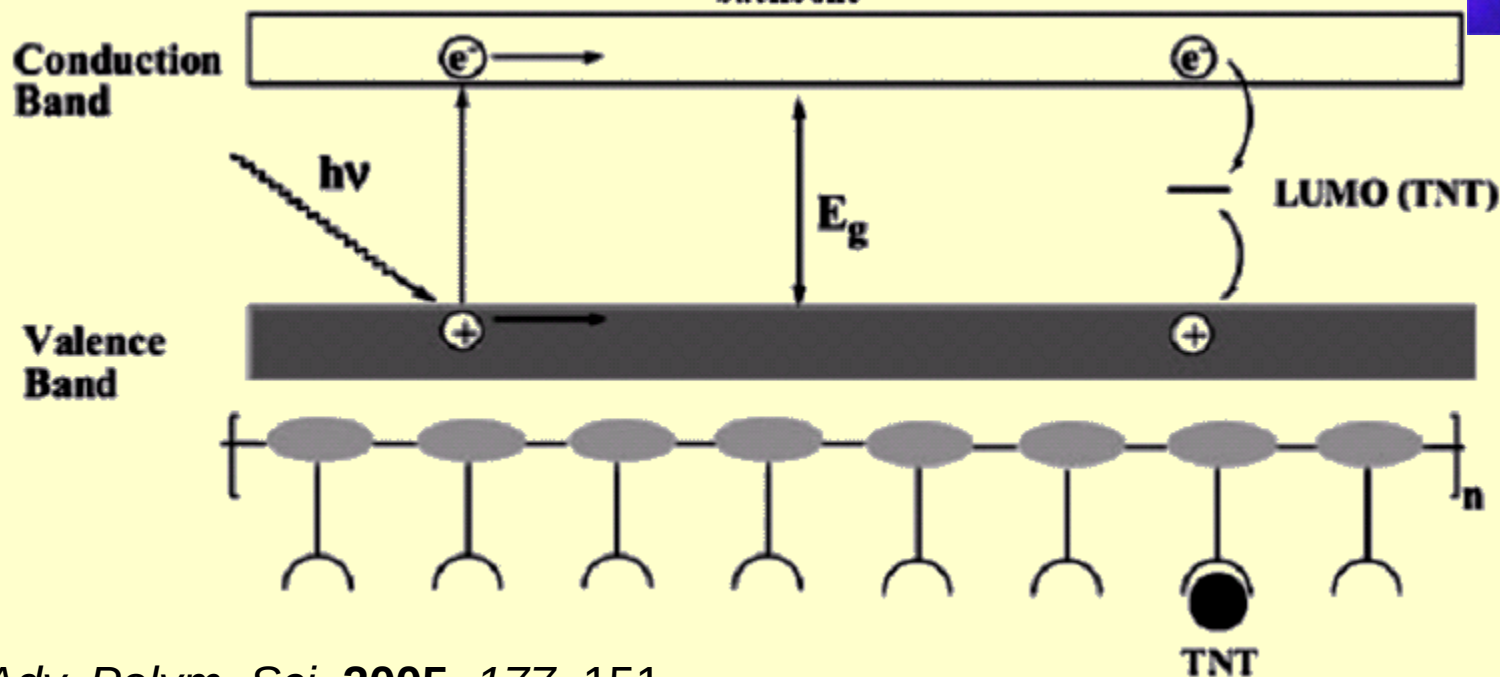
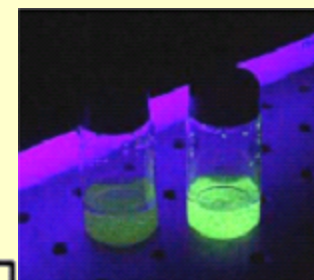
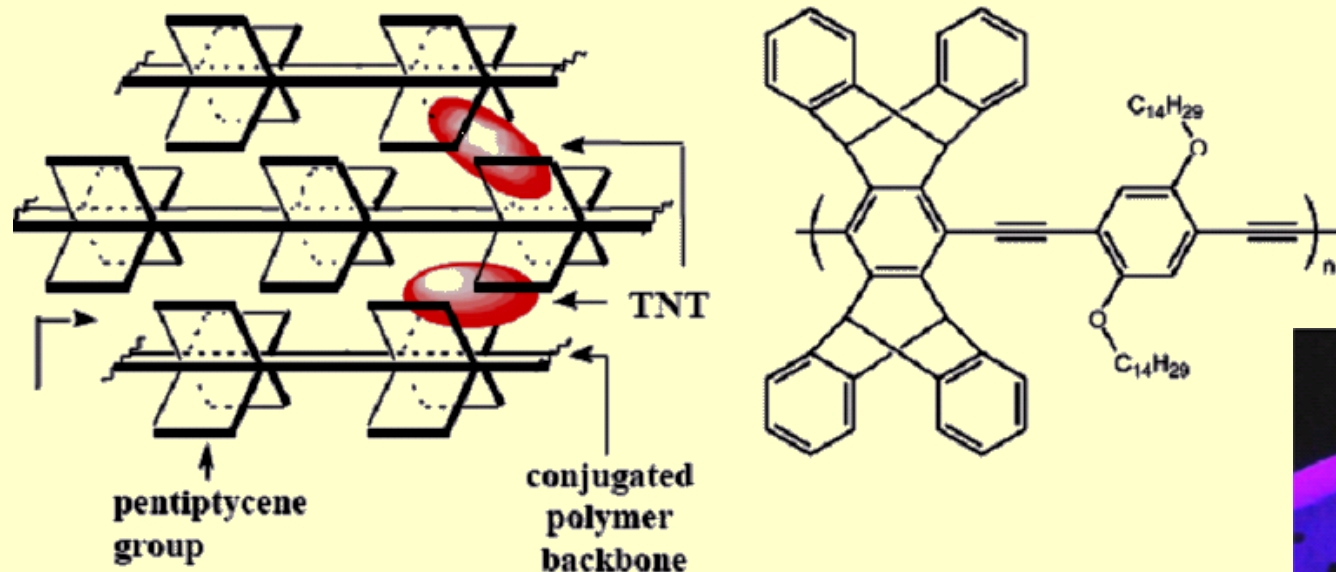


Christopher Weder





# Amplified Fluorescence Polymers



# Fido™ Explosive Detection



*Dr. R. Chidambaram PSA Govt of India*

*Dr. Shubananda Rao Director HEMRL*

*Prof. Ramgopal Rao EE*

•*Dr. Jasmine (John Hopkins)*

*Dr. Baldev Raj Director IGCAR*

*Dr. Chandrasekhar Nair BIGTEC LAB TEAM*

*Dr. Lazar Mathews NPMASS*

*Mr. Ashok Kumar Majji*

# Design Strategy of Device

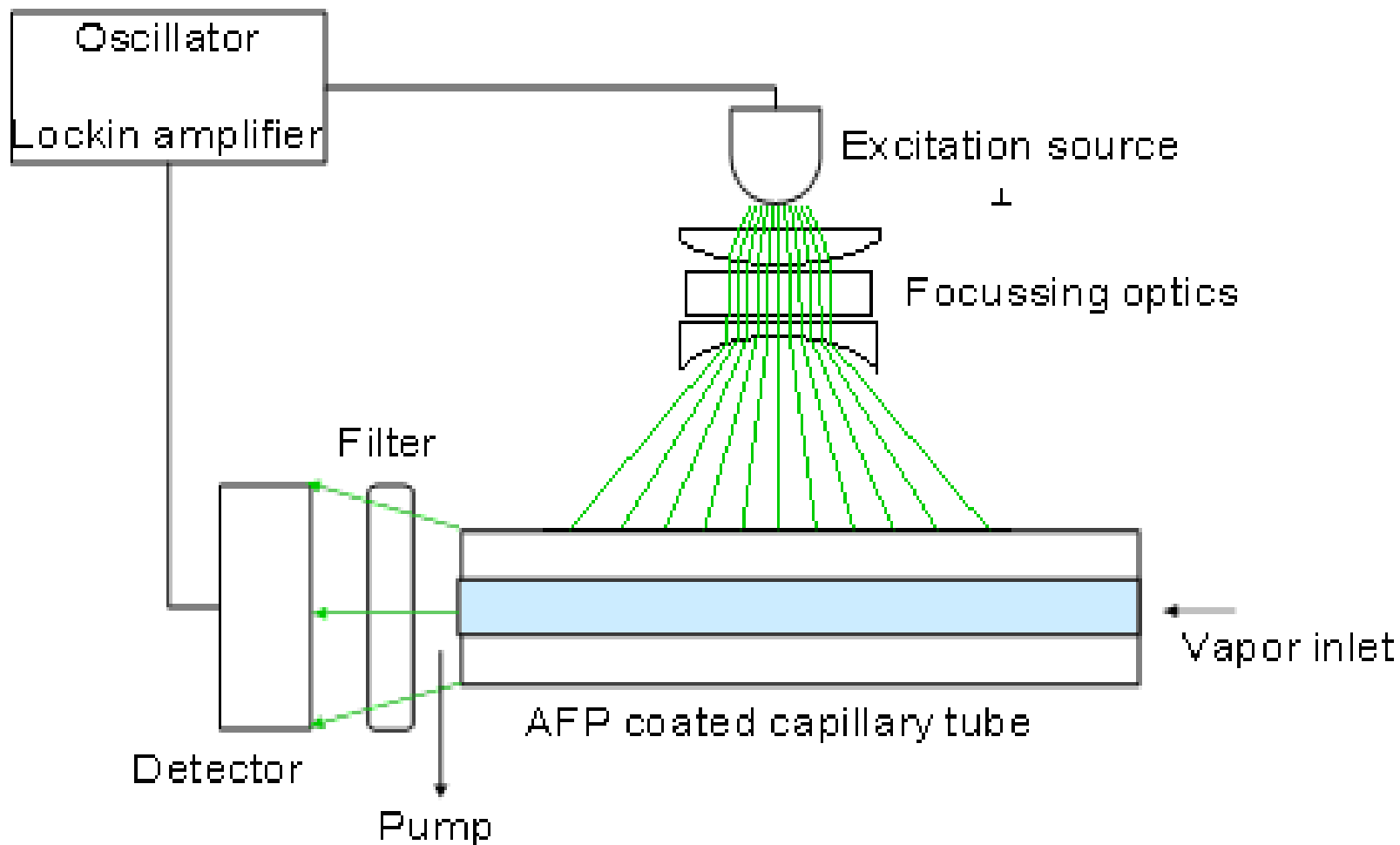
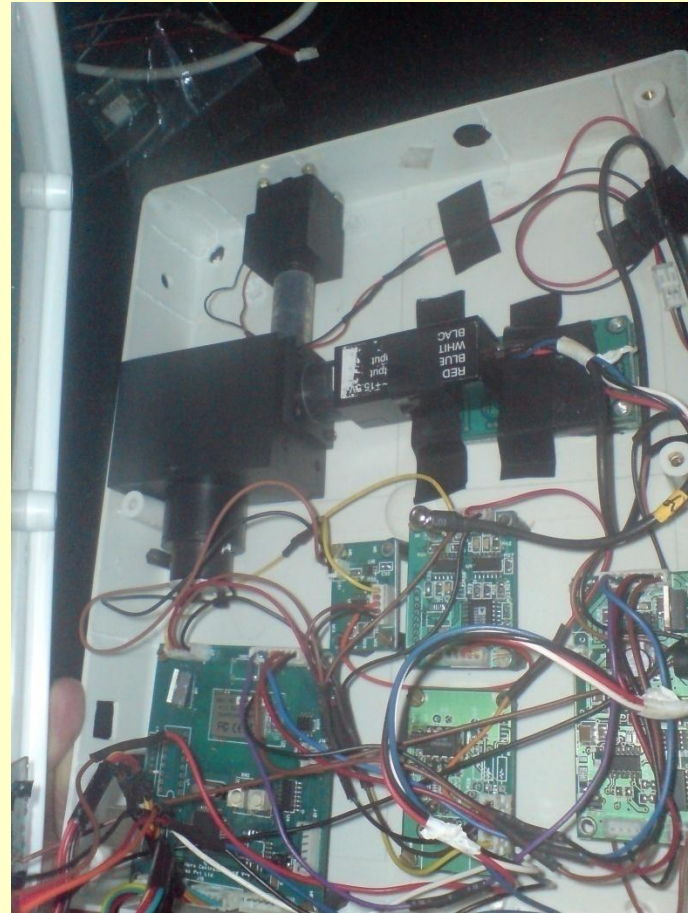


Figure : Schematic of the vapor detection optics.



# First Generation Handheld Device for detection of TNT and RDX at Room Temperature

**SIDE VIEW**



**TOP VIEW**



**IITB  
&  
BIGTEC Labs**



# Test Results at HEMRL

- The BEAGLE-Z device was tested at HEMRL on 6<sup>th</sup> Oct 2010 for various explosives and following are the results:

| Explosive Composition | Detection (+ or - ) |
|-----------------------|---------------------|
| HMX                   | +                   |
| Jaggery               | -                   |
| C-4                   | +                   |
| RDX                   | +                   |
| PEK                   | +                   |
| TNT                   | +                   |
| Compoisition B        | +                   |
| Kitchen Salt          | -                   |
| TETRYL                | +                   |
| Sheet Explosive       | +                   |
| PETN                  | +                   |
| SEMTEX                | +                   |
| Ammonium Nitrate      | -                   |