

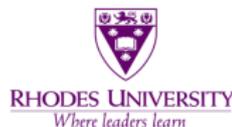
# Phototransferred Thermoluminescence and phosphorescence related to phototransfer in annealed synthetic quartz

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and**

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**Rhodes University**

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# Quartz, SiO<sub>2</sub> & Point Defects

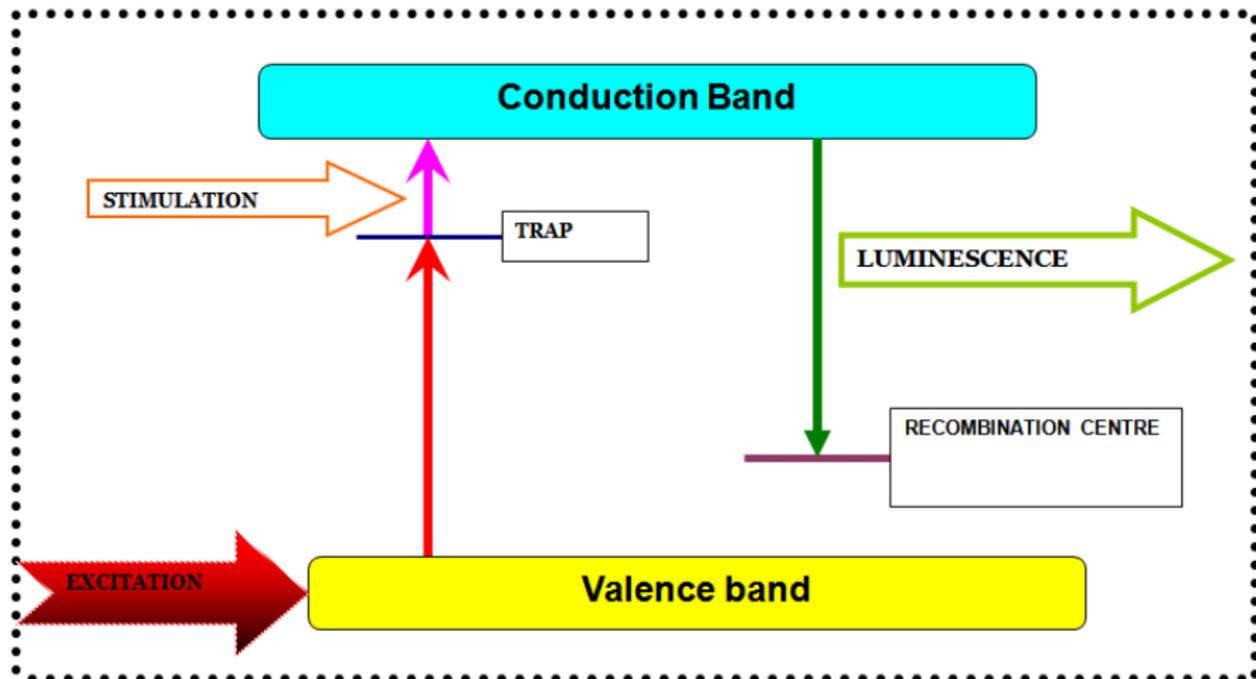


Google images: [www.mindat.org](http://www.mindat.org)

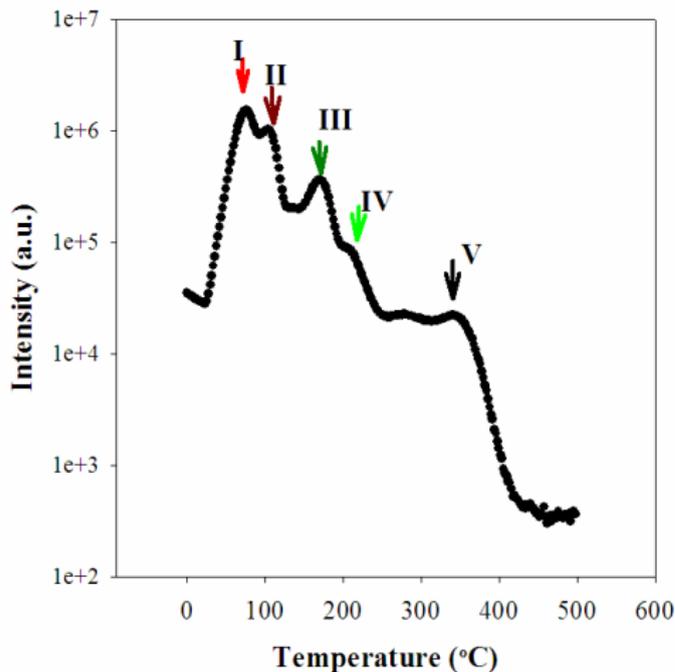
- Ideal for dosimetry, records amount of **ionizing radiation**

- Lattice or crystal defects: **discontinuities**

# What is Luminescence?



# Thermoluminescence (TL)



- Luminescence observed when an irradiated material is heated at a controlled rate.

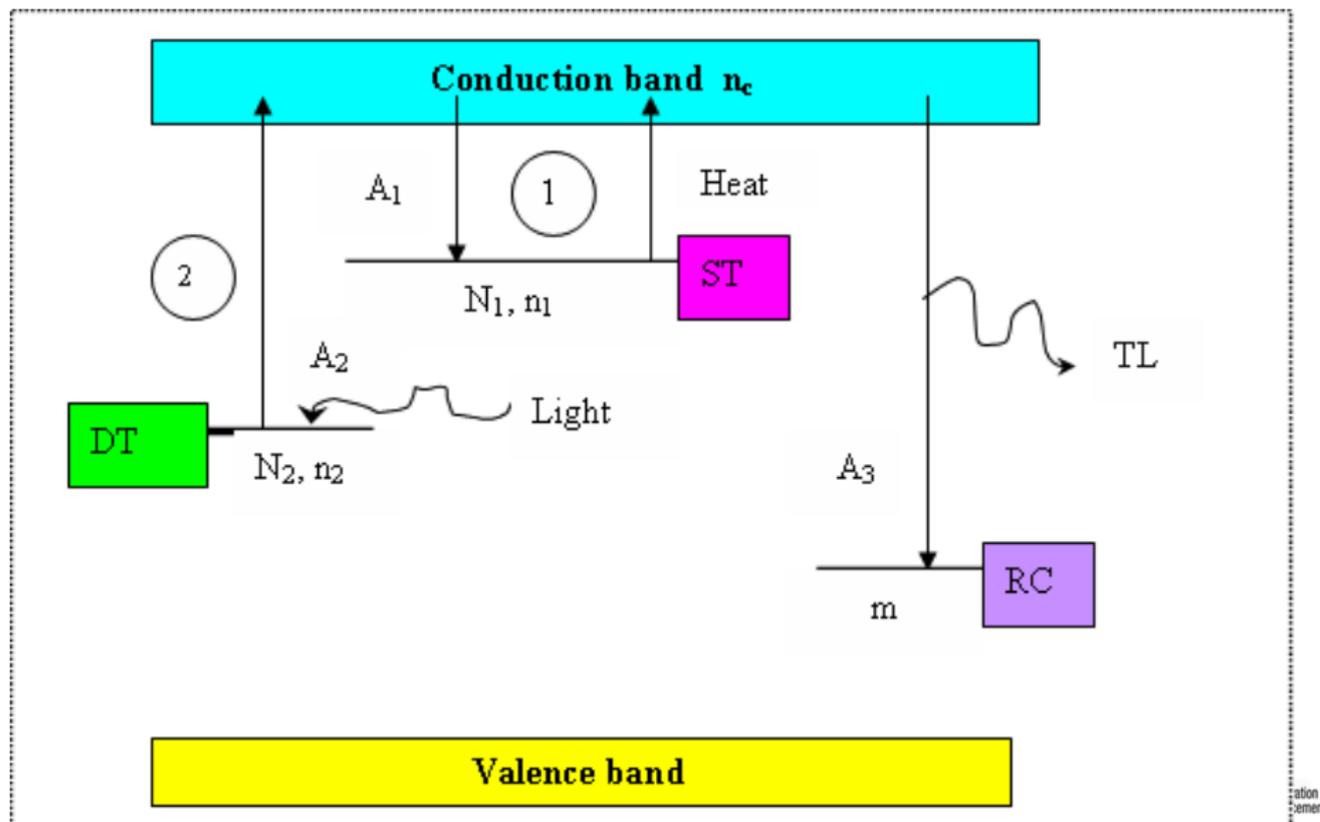


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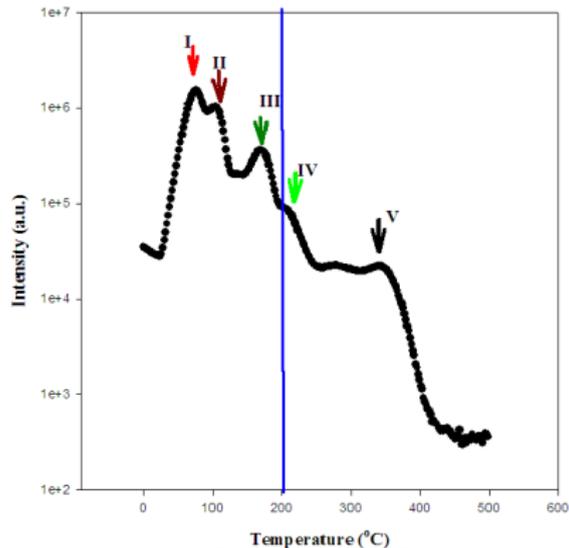
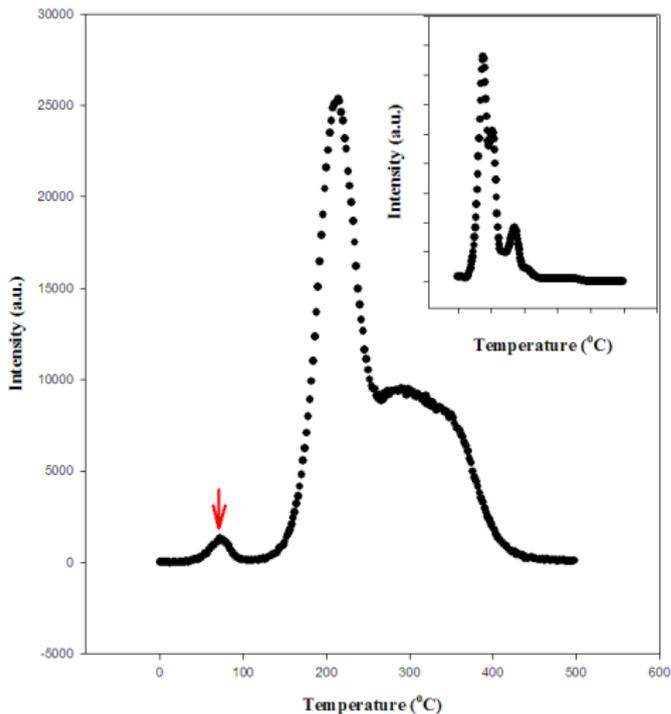


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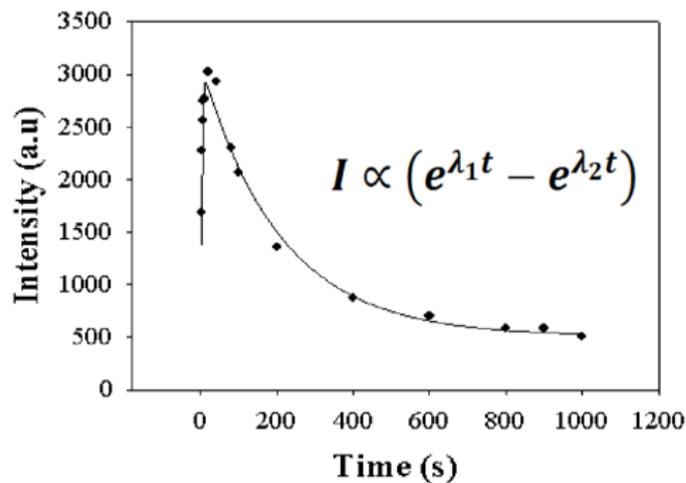
# Phototransferred Thermoluminescence (PTTL)



# Phototriggered Thermoluminescence (PTTL)



# PTTL Vs Illumination



- Irradiate
- Preheat
- Illuminate for  $t_x$
- Record TL

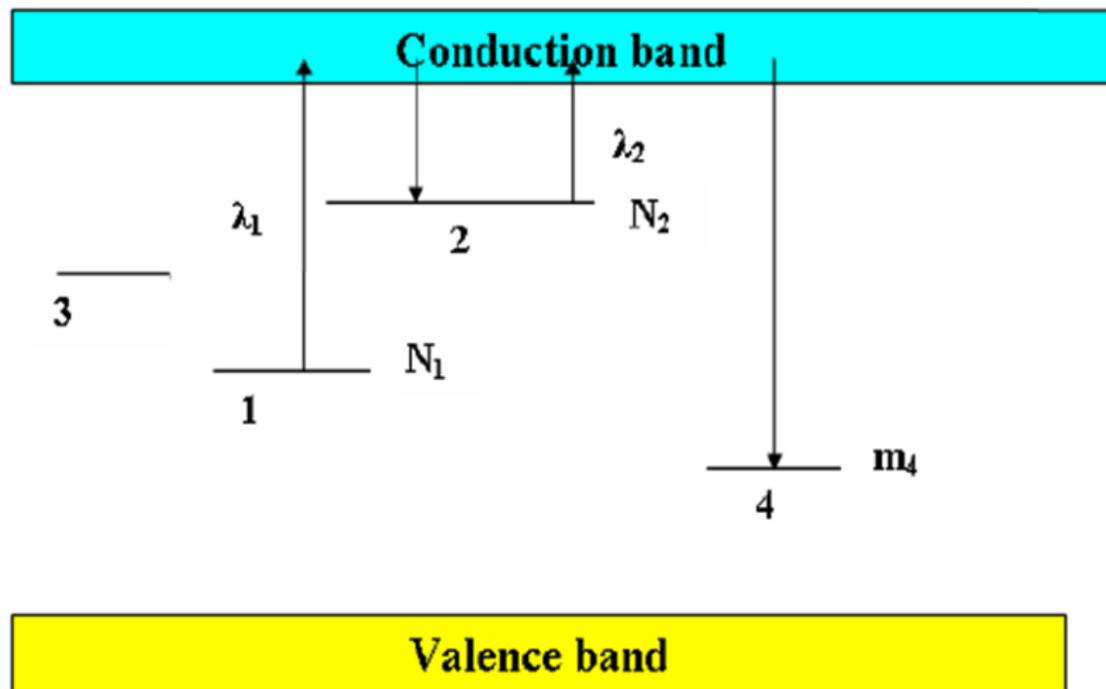


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# PTTL Vs Illumination

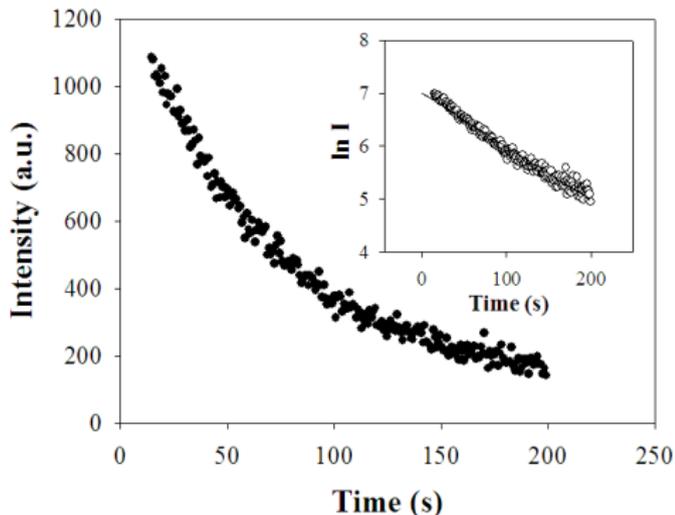


# Phosphorescence

- TL measured as a function of time at constant temperature.

$$I(t) = I_0 \exp(-p t)$$

$$p = s \exp(-E/kT)$$

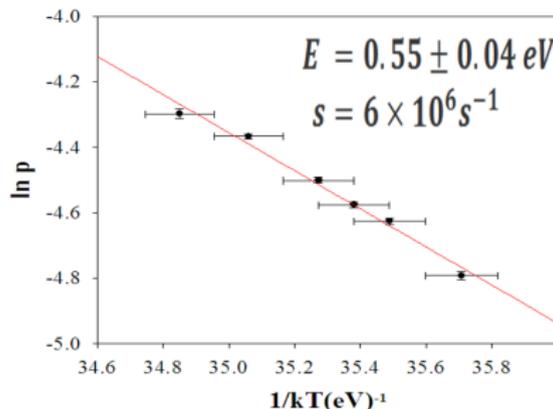
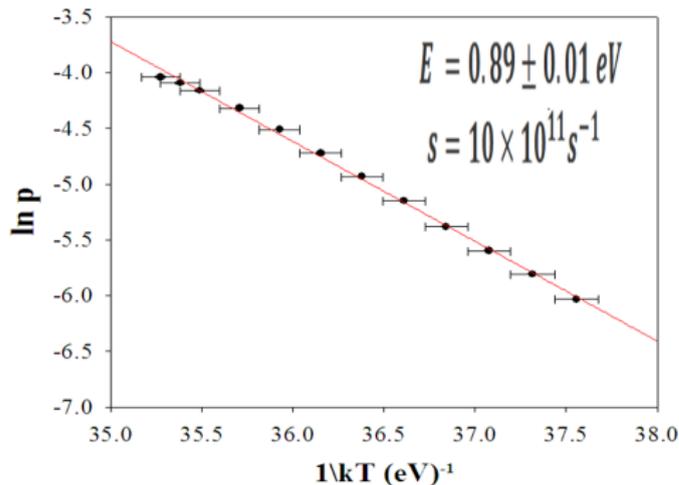


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# Phosphorescence before and after phototransfer

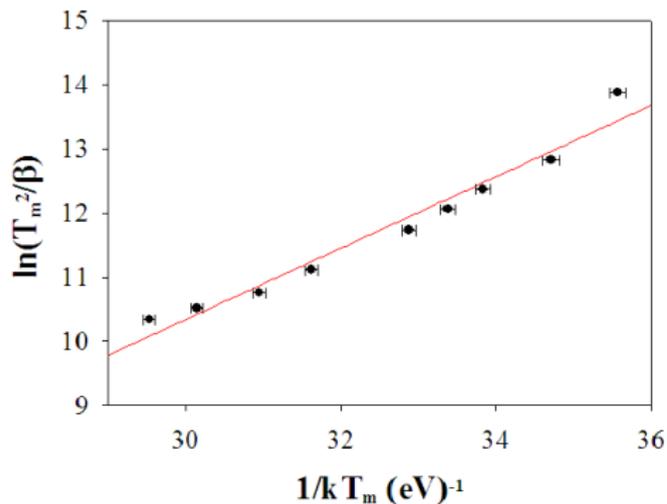


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# Variable Heating Rate



- $$\ln\left(\frac{T_m^2}{\beta}\right) = \frac{E}{kT_m} + \ln\left(\frac{E}{sk}\right)$$
- $E = 0.56 \pm 0.04 \text{ eV}$   
 $s = 4 \times 10^6 \text{ s}^{-1}$ .

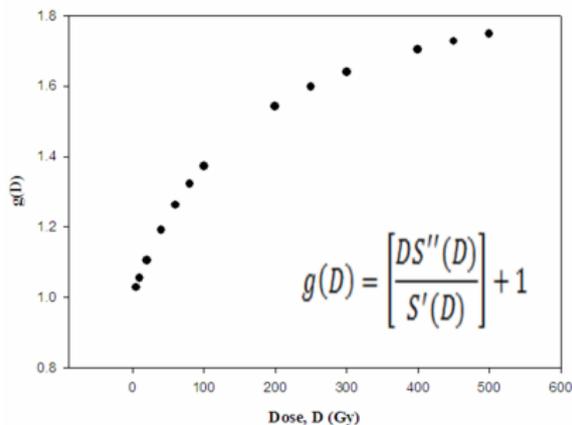
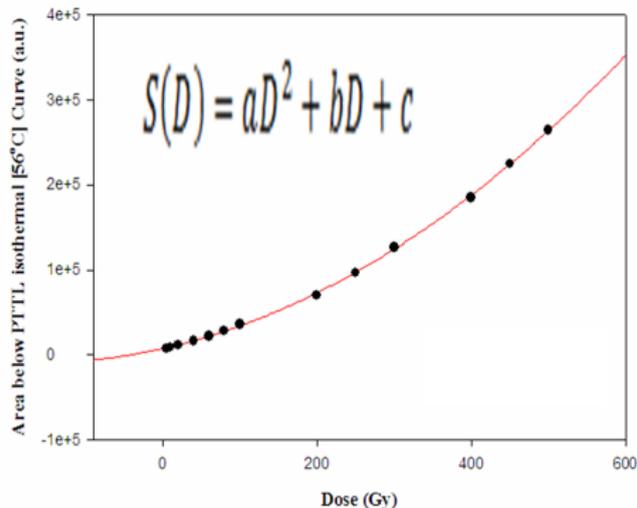


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# Dose Response of Phototransferred Phosphorescence



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# Conclusion

- One unstable, shallow trap is phototransferred.
- Phosphorescence at ambient temperature is evidence of instability of this trap.
- PTTL vs ILL = Peak; b/c relative concentration of electrons and holes.



# Conclusion

- **One unstable, shallow trap is phototransferred.**
- **Phosphorescence at ambient temperature is evidence of instability of this trap.**
- **PTTL vs ILL = Peak; b/c relative concentration of electrons and holes.**
- **Trap: first-order and  $E = 0.55 \pm 0.04\text{eV}$ .**
- **Dose response of PTTL intensity is superlinear.**



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THANK YOU

GRACIAS  
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