

# DYE SOLAR CELL RESEARCH

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# BACKGROUND

➤ SA is dry: Annual rainfall average of 450 mm compared with a world average of 860 mm

➤ On upside, we have some of the best sunlight in the world

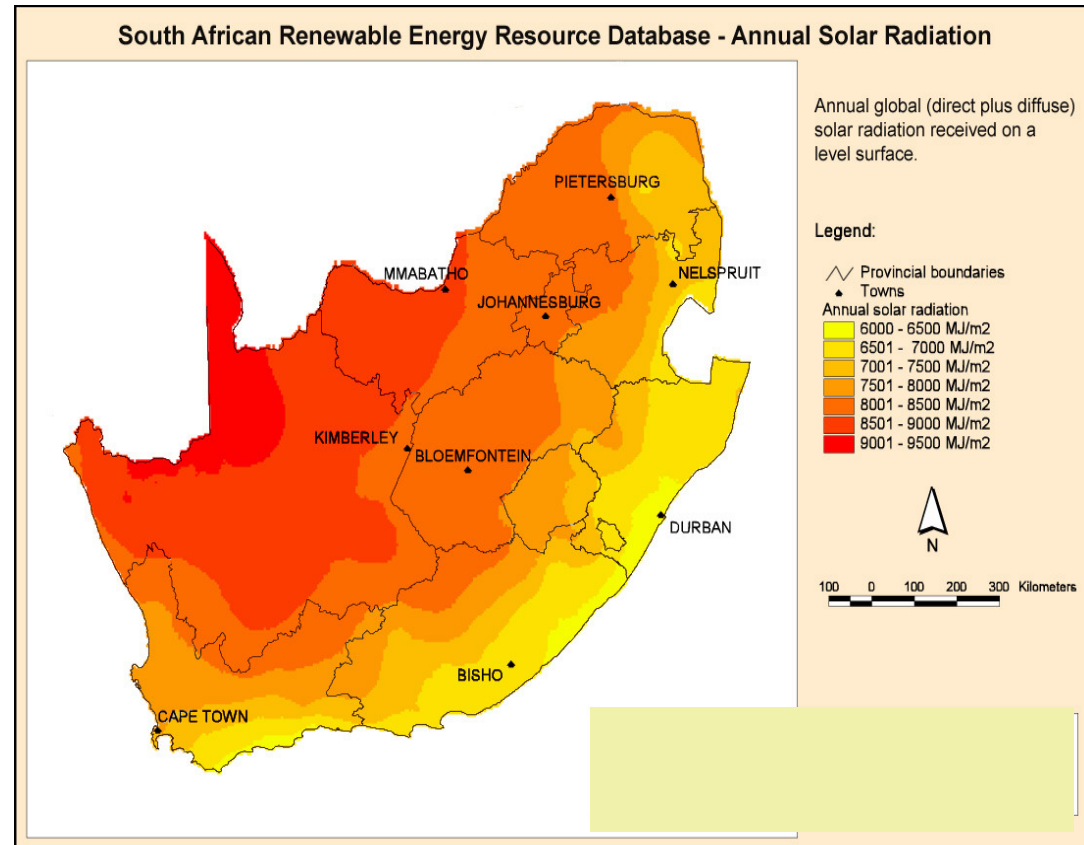
➤ Average daily solar radiation varies between 4.5 and 6.5 kWh/m<sup>2</sup>, compared to about 3.6 kWh/m<sup>2</sup> for parts of the United States and about 2.5 kWh/m<sup>2</sup> for Europe and the United Kingdom

➤ PV market in SA is relatively small

➤ Mainly used for:

- Telecommunication
- Off grid (lighting and electronic media)
- About 200 000 off-grid installations

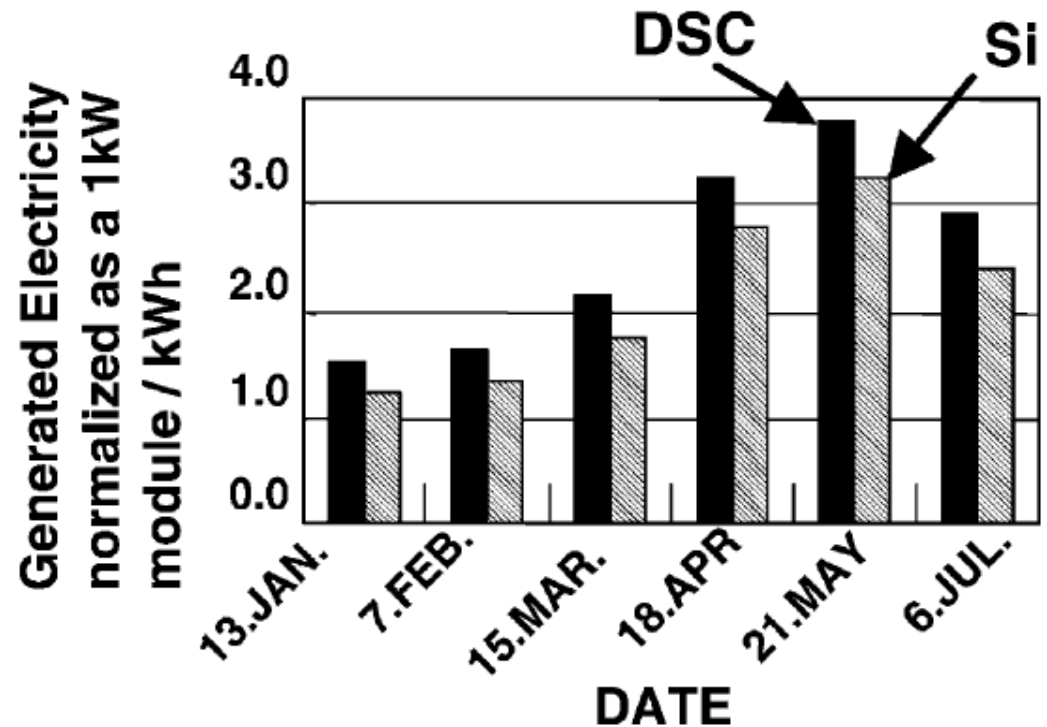
➤ Energy payback time,  $t_{PB} \sim 3$  years (EU); In SA high radiation areas  $t_{PB} \sim 1.5$  years



# CSIR DYE SOLAR CELL RESEARCH

## Why Dye-solar Cells?

- Low cost and ease of production
- Temperature insensitive
- Bifacial configuration – diffuse light
- Less sensitive to angle of incidence
- Transparency
- Colour can be varied
- Outperforms a-Si:H cells
- Energy pay-back time is a few months
- ~ 20% higher energy output than Si



# CSIR DYE SOLAR CELL RESEARCH

## Major Research Areas:

### *Improvement in DSC Efficiency*

Implementation of  $\text{TiO}_2$  nanotubes in cell  
 $\text{Al}_2\text{O}_3/\text{TiO}_2$  nanoparticle composite synthesis and application

### *Improvement in Long-Term Stability of DSCs*

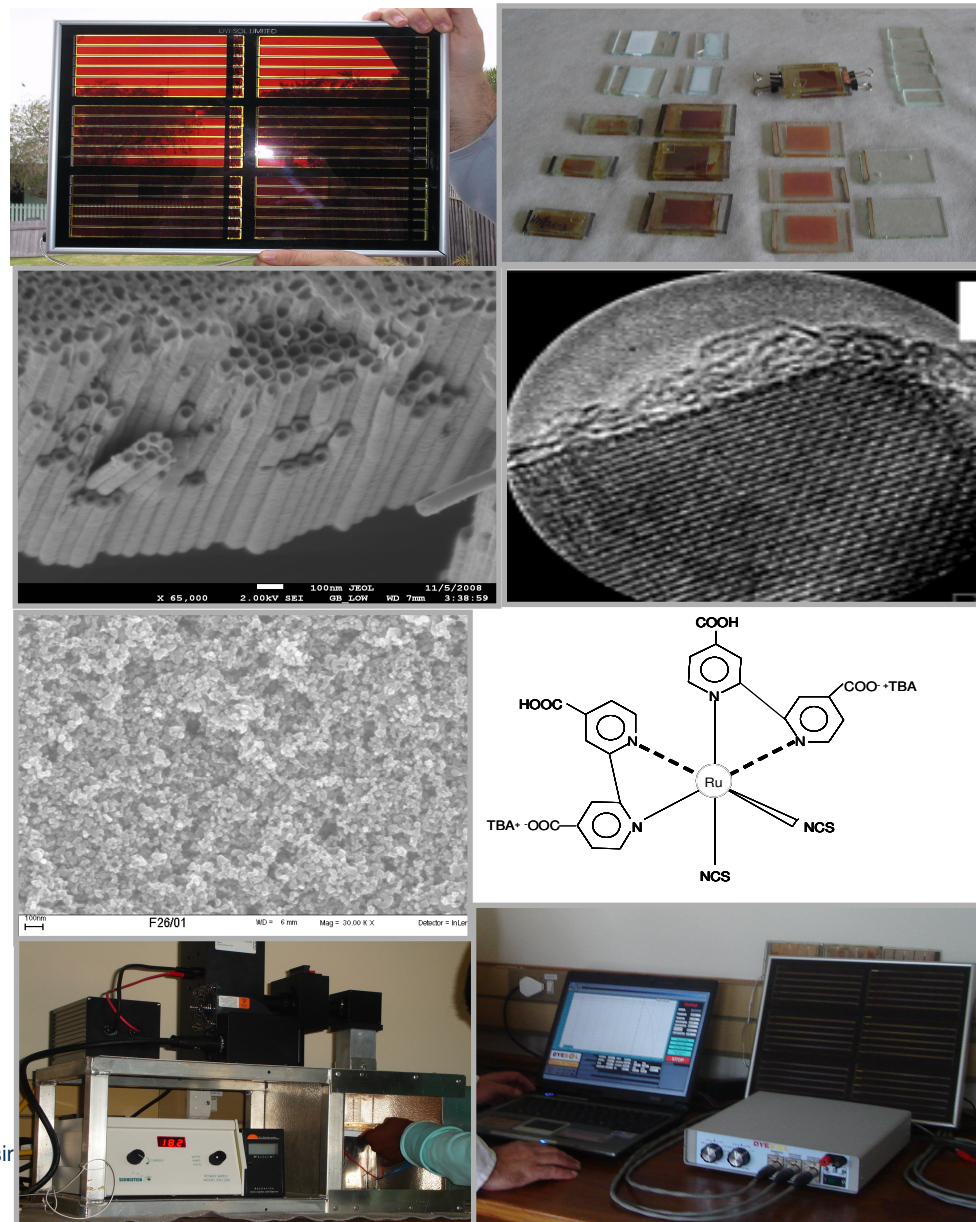
Studying the effect of reverse biased potentials on the stability of the cell  
Outdoor testing: DSC performance vs. a-Si and c-Si cells over extended periods

### *Cell Cost Reduction*

Novel dye synthesis from CSIR collected Ru waste products

### *Cell Characterisation Techniques*

Investigation into new techniques for characterisation of closed and open cells

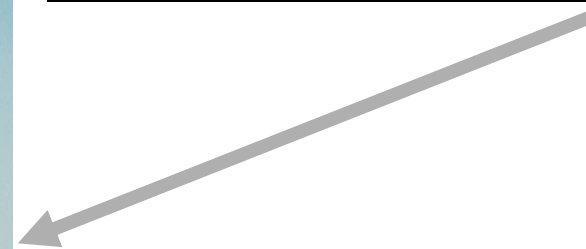
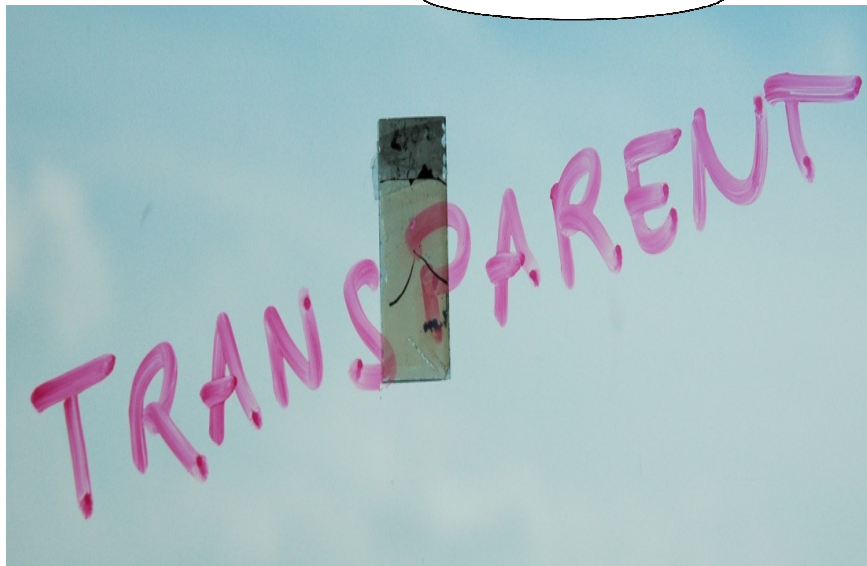
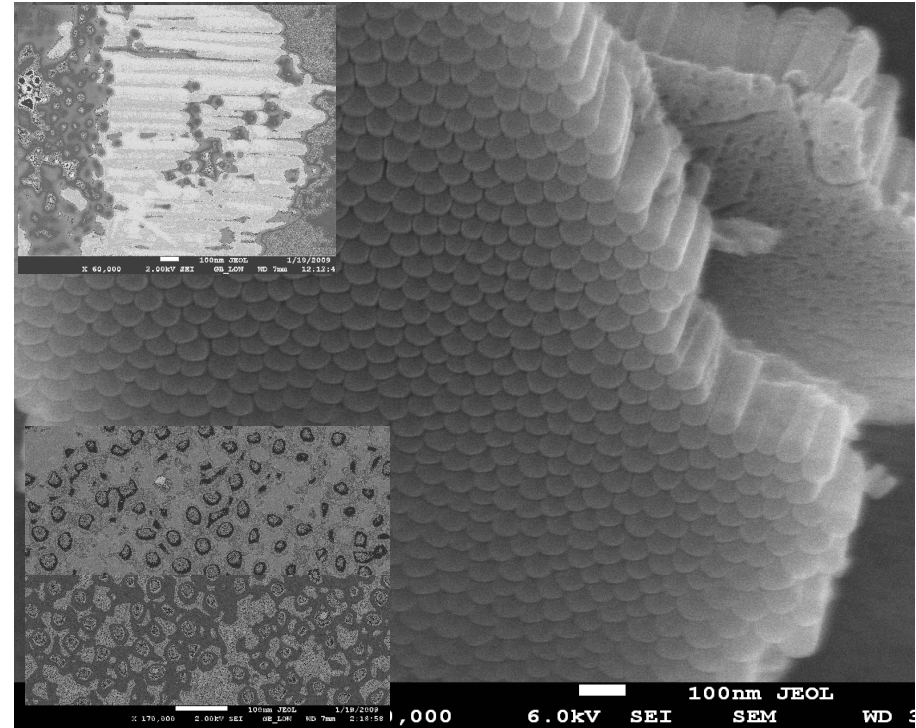
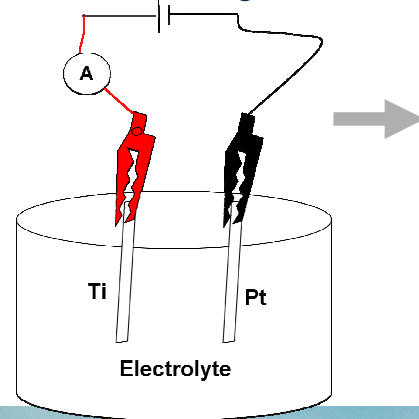




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## TiO<sub>2</sub> Nanotubes

**Aim:** Implementation in DSCs for improvement of electron transport and manufacturing of transparent cells



# CSIR DYE SOLAR CELL RESEARCH

- Nano-TiO<sub>2</sub> particles
- Dye
- Solid Electrolyte
- Paste stability
- Cell stability
- Device Modeling - University of Fort Hare

# COLLABORATIONS and LINKS

Energy Research Centre of the Netherlands (ECN)	Electroanalytical analysis of Dye solar cells
Nelson Mandela University	Field testing of DSCs
University of Fort Hare	Modeling
Solar Cell Research Center. KIST, Korea	Study of the charge transport in DSCs
National Centre for Nanostructured Materials	Characterisation facilities
University of the Western Cape	Guidance in training of formal degrees



**Thank You**

**CSIR**

*our future through science*