

The Institute of Photonic Sciences

ICFO-KNUST INTERNATIONAL SCHOOL ON THE FRONTIERS OF LIGHT

PHOTONIC SCIENCES: APPLICATIONS AND OPPORTUNITIES

Presented By:

Akash Arya Nanostructured Engineering and Modelling Laboratory (NEMO)





Affiliation MEMS Department Indian Institute of Technology → Bombay, Powai , India

MY HOMETOWN



AGRA CITY OF LOVE



WHAT DO YOU THINK ABOUT THESE ?





HOW ABOUT THIS ?





DEVELOPMENT OF LASER CLEANING System for solar photovoltaic panels

MTech, IIT Bombay



MENU OF THE TALK

PROBLEM OBJECTIVE

CONCEPT DEVELOPMENT

SCHEMATIC DIAGRAM

COST ANALYSIS

OVERVIEW

MATERIALS NEEDED



PROBLEM STATEMENT

OBJECTIVE

- The accumulation of dirt and dust on solar panel surfaces represents a significant barrier to the efficient production of solar energy.
- We propose a simple, cost-effective, and robust technique that leverages to clean through atmospheric pressure laser ionisation technique.



Study ?

01	02	03
A uniform layer of 10 g accumulated	Accumulated uniformly with 50 g of dust	Research shov mean of daily loss in a year
reduce power up to 25%	reduce power up to 50-60%	

Hussain, A., Batra, A. & Pachauri, R. An experimental study on effect of dust on power loss in solar photovoltaic module. Renewables 4, 9 (2017) In long periods without rain, daily energy losses can be higher than 20%.

04

ows ly energy r is In desert area, the accumulation of dust on PV panel surface is very high.

The reduction in solar efficiency due to dust on PV panel is approximately 40%.

CONCEPT DEVELOPMENT

- The system would work on the effect of ionizing(corona positive) the wind using a laser.
 Once the wind is ionized, it attracts the negatively charged dust particles and takes them off.
- The system would use a PM Sensor for the process
- Then, a metal is placed at the top to collect the dust particles.
- Once dust particles are collected, they are disposed off and the cell can operate again

https://news.mit.edu/2022/solar-panels-dust-magnets-0311



DIAGRAM

WORKING PRINCIPLE



LASER BEAM INJECTION

DIAGRAM

WORKING PRINCIPLE



DUST REMOVAL

HOW TO IONIZE WIND?



Du, S., Wang, TJ., Zhu, Z. et al. Laser guided ionic wind. Sci Rep 8, 13511 (2018).

DIAGRAM

FUNCTIONING OF THE SYSTEM

Step 1- The PM Sensor detects the dust concentration 20 g/m2. If the concentration is greater than this, the sensor starts functioning.

Step 2- The wind ionizer compartment starts operating. The laser of the wavelength of 800 nm at a repetition of 1 kHz is used to ionize the wind with a pulse duration of 25fs.

Step 3- The copper electrode would then start emitting a laser which would ionize the wind. This would attract the negatively charged dust particles from the panels.

Step 4- The movable dust collectors come into the picture once the dust level is below 20 g/m2. Then, the wind ionizer stops and rotary pump starts. Step 5- The rotary pump evacuates the dust particles and the system goes back to its initial phase.



MATERIALS NEEDED

HIGH VOLTAGE SOURCE

100kV Voltage source

WIND IONIZATION EQUIPMENTS

DC Generator, Beam Splitter, Spherical **Copper Electrode**

PM SENSOR

Particulate Matter Density 2 g/m2

Specifications-Capacity UPTO 10-2 Pa

LASER BEAM

800 nm wavelength, 1000W

ROTARY PUMP

MOVABLE ELECTRODES

A layer of dust collector over the electrodes

APPROX. TOTAL - \$375

COST ANALYSIS







SOURCES : ALIBABA.COM **INDIAMART.IN**







ADVANTAGES





THIRD

REDUCE DUST TO EXTREMELY LOW LEVEL

CHALLENGES AND FUTURE IMPROVEMENTS



THIRD

COMPRESSING THE SYSTEM TO BE USABLE FOR INDUSTRIES

PHYSICS IS, HOPEFULLY, SIMPLE. BUT PHYSICISTS ARE NOT

EDWARD TELLER

THE END



MEMS Department

www.akasharya.in

Any Question?