NEWSLETTER

OPTICA
Advancing Optics and Photonics Worldwide

Optics for Energy

CONTENT

AUG, 2025_VOL4

FOREWORD

Mission and Goals

The groups aims is to connect professionals and students in optics and energy through: Technical events ,Educational webinars, Networking activities, Social media engagement.
MUCH MORE would be possible with your contributions!

Meet the team

Chair
Dr. rer. Nat. Banafshe Zakeri
HySON Institute
zakeribanafsheh@yahoo.com

Vice Chair
A/Professor. Georgios Arnaoutakis
Hellenic Mediterranean University
arnaoutakis@hmu.gr

Event Officer
M.Sc. Idris Adeshina Sulaimon
Institut National de la Recherche Scientifique (INRS)
sulaimonidris61@gmail.com

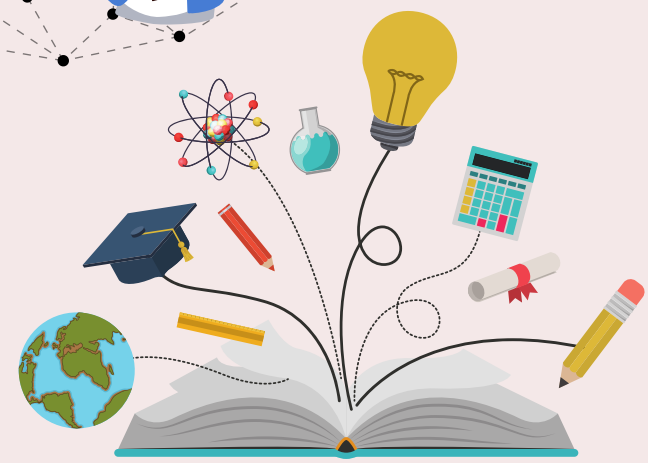
Social media Officer
M.Sc. Rodgers Mutugi Gichuru
Multimedia University of Kenya (NIOL)
roycerodgers2@gmail.com

Webinar Officer
Prof. Ahmed Morshed
Ain Shams University
ahmed_morshed@eng.asu.edu.eg

OPENING MESSAGE

By Banafshe Zakeri

In doing everything meaningful, there are some values attached to it. Values are important, they remind us of what we stand for. They are like a roadmap which gives us a picture of how we should direct our steps towards those goals. These are our three core values at OPTICA Optics for Energy Technical Group;
Connection, Inspiration, Education.



We believe in making meaningful and lasting connections to share our work and promote others. The world would be small if the connections are broad.
We believe in storytelling to inspire each other by sharing our challenges, visions, and dreams
We believe in education delivered in a powerful, effective, fun, and interesting way.

WE NEED YOUR CONTRIBUTION

Make your research more visible

Send us your recent publication.
We promise
to make a comprehensive review
for a broad audience

Give us a shot from your camera

Submit any light-highlighting photo
whether from your lab,
or a sparkle of light that captured your eyes.

Share your story

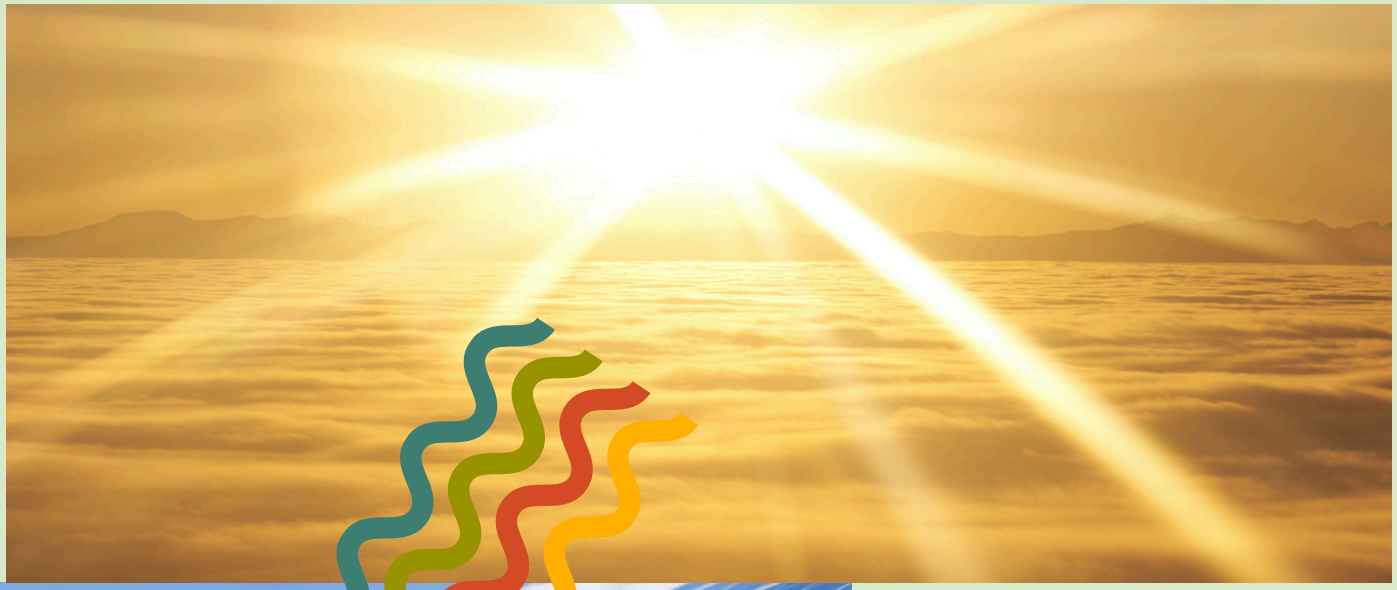
Inspire others with your story

Click and drop

THE ROLE OF OPTICS

in green energy cycle

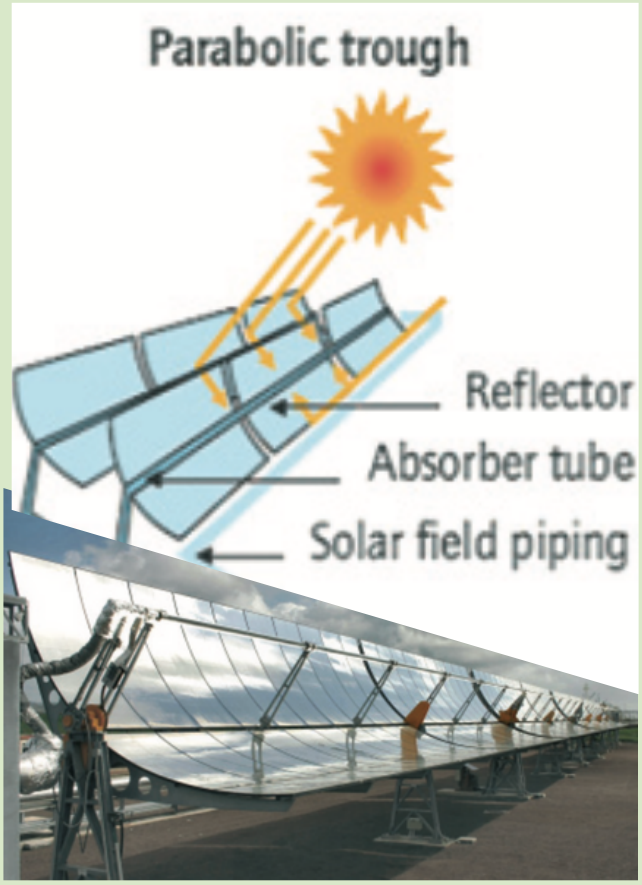
Efficiently using the benefits of clean energy resources like solar, wind, and hydropower is, more than anything, a result of technological improvements in the production, transmission, and application (operation) of those energies. With a deep and already established knowledge in optics and photonics, both fundamental and practical, the science of light plays an important role in our journey towards a carbon-free future. Especially in solar cells and photovoltaic energy conversion, where incomplete light trapping causes low efficiency in energy production, advances in controlling light at all scales could reduce the gap between theory and practice*, leading to the development of techniques for solar energy conversion with higher efficiency. Here is a list of some optical advances which had a great impact on energy conversion in solar cells.



* Albert Polman and Harry A. Atwater, “Photonic design principles for ultrahigh-efficiency photovoltaics”, nature materials 11, 2012

Parabolic light concentrators

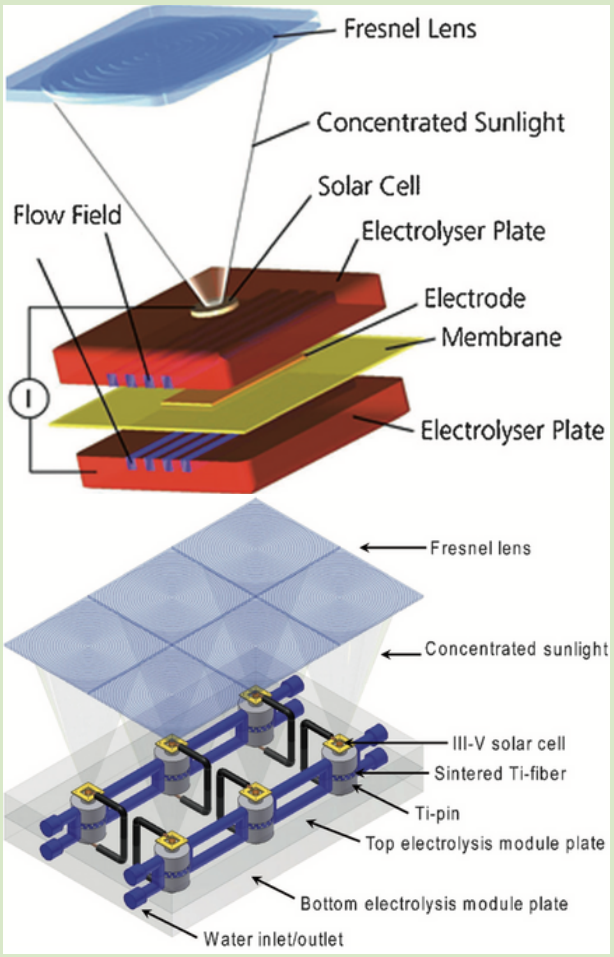
- International renewable energy agency (IRENA)
- Malik I. Al-Amayreh, et al., *Energy Reports* 6 (2020)



Concentrating solar powers concentrate sunlight onto a receiver using collimating optics like mirror or lens. Among various types of concentrators, those using parabolic mirrors are the most commercially mature technologies. While they produce primarily electricity, they also produce high-temperature heat that can be used for industrial processes. A parabolic solar dish, for example, was used in a hybrid light-thermal system to benefit solar energy for both heating water and electrical energy generation by transmitting light through fiber optics to the indoor photovoltaic system.

Fresnel lens concentrators

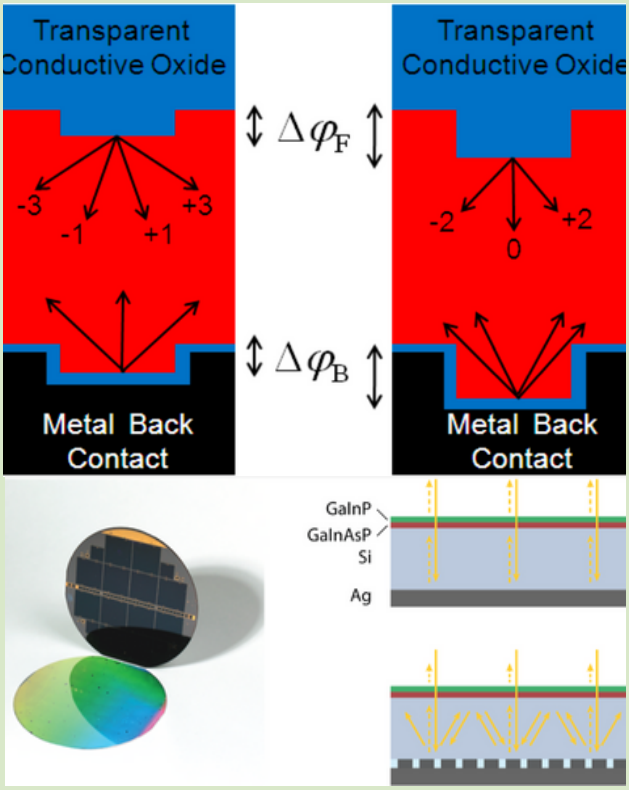
- Sebastian Rau, et al., *Energy Technology,* 2, 2014



For developing high-quality concentrator systems, Fresnel lens can be used. The advantage of using these flat optics components is that they can be directly fabricated on a glass sheet. Researches at *Fraunhofer Institute for Solar Energy Systems ISE* developed an all-glass Tandem solar cell using Fresnel lens which showed more than 22% module efficiency for outdoor measurements. The developed solar cell was applied for generating high-efficiently solar-hydrogen. The multijunction solar cells under concentrated illumination by Fresnel lens were directly coupled with proton exchange membrane (PEM) to generate hydrogen directly from solar energy.

Light trapping by diffraction grating

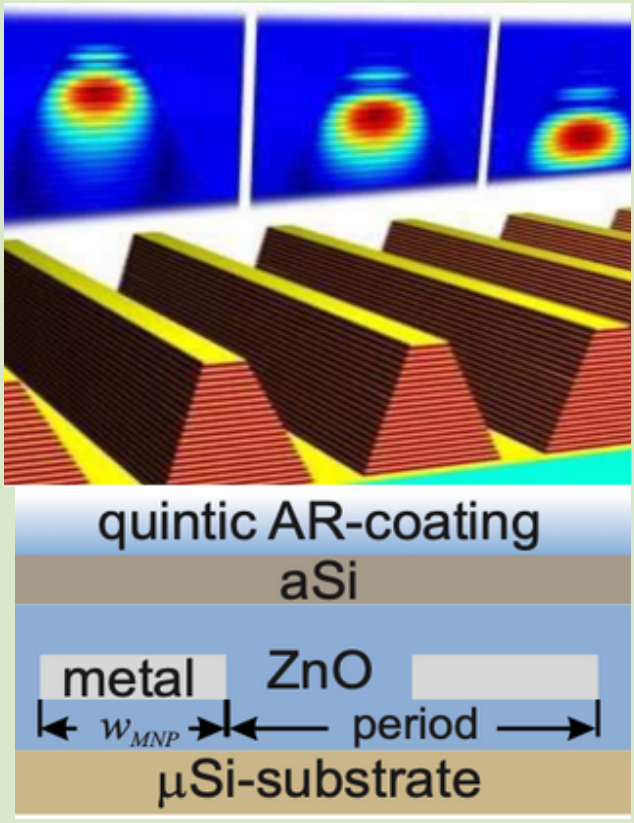
- **Darin Madzharov, et al., *Optics Express* 19, 2010**
- **Andrea Cordaro, et al., *ACS Photonics* 10, 2023**



The light can be trapped inside the active layer of the solar cell using optical elements. In thin film solar cells, periodic surface structures (gratings) were used to increase the light path-length inside the active layer for better harvesting of solar radiation to a maximum possibility. The scattered light inside the silicon layer could be controlled with the period and height of the front- and back-gratings which influenced the quantum efficiency of the active layer. Another advantage of using nanopatterned diffractive elements in solar cell structures is to selectively enhance light trapping in Near-IR spectral range which has normally an incomplete absorption in Silicon-based solar cells. Research showed an enhanced efficiency of a multijunction solar cell using a nanopatterned diffractive silver back-reflector.

Photonic nanostructure

- **Galib Hashmi, *Global Journal Inc.* 2013**
- **Stephan Fahr, *Applied Physics Letters* 95, 2009**



Metamaterial's properties such as light absorption and polarization found to be promising in designing high efficiency solar cells. Anti-reflection coating of solar cell, made of metamaterial, for example, can block the reflection and increase the efficiency without polarization effect. Nanostructured metamaterials can be also used in the intermediate layers of solar cells with which the band gap can be tuned, thus covering the whole solar spectrum and increasing efficiency.

Inspiring story

By Rodgers Gichuru

Each of us carries a spark of curiosity, usually small at first but capable of igniting transformative ideas.

My journey started in the highlands, where the morning sun rays filtered through misty hills and lit the countryside with a quiet promise of its importance. A faint rainbow visible through the haze, I was amazed. Why did that happen? What was light, really? What else could light do? That moment, seemingly simple, marked the beginning of a lifelong pursuit.

In that modest classroom, a physics textbook in hand, Optics is listed as a branch of physics, the few optical instrument are the worn-out lenses and mirrors from years of use. Crouching such that the line of sight aligns horizontally with the surface of the table, no fancy lasers just rudimentary equipment to experimentally verify the Snell's law and the thin lens equation. I found myself drawn to the interplay between nature and physics. While others may have let questions about refraction, imaging, scattered, or refraction pass, I found myself returning to them scribbling notes, experimenting with anything that interacted with light.

I wasn't just curious about light; I was drawn to how something so ordinary could hold so many mysteries, it was a calling. This early fascination matured into a passion for optics. I pursued physics, not just to find answers, but to learn how to ask better questions. Along the way, I discovered the power of mathematics, the elegance of wave theory, and the satisfaction of experimentation. From the misty hills of my childhood to an optics research lab investigating novel light applications using metamaterials, the source of my motivation remains the same, a deep, enduring curiosity about light and its possibilities.

What about your story? Share it with us with a Click & drop

Optical societies for energy around the world

Born from a vision of bridging the gap between cutting-edge research and industrial applications, the **Society of Energy Photonics** has evolved into interdisciplinary platform that connects scientists, engineers, and innovators across borders and disciplines. Founded in 2015 and headquartered in Singapore, SEP was initiated by a diverse group of researchers passionate about energy and light-based technologies. The society was born from a deep realization: the world needs a dedicated, global platform to integrate advances in materials, nanotechnology, photonics, and energy applications-accelerating the full transition from fundamental research to real-world implementation.

From its earliest days, SEP has recognized that innovation does not happen in isolation. Through its flagship annual gathering, the **International Conference on Energy, Materials and Photonics (EMP),** the society provides a high-impact forum for open exchange and interdisciplinary dialogue. Each EMP reflects SEP's commitment to scientific excellence, inclusiveness, and international collaboration, with past editions hosted in France, China, Singapore, Malaysia, and Canada. To date, SEP has brought together more than 3,000 participants from 30+ countries, bridging the academic, industrial, and regional divides.

SEP actively collaborates with leading universities and institutions including Nanyang Technological University, Southern University of Science and Technology (SUSTech), IEEE, and OPTICA. These partnerships support joint initiatives, talent development programs, and co-branded events. Its leadership including figures like Prof. Xiao Wei Sun, Prof. Lars Samuelson, and Prof. Siyu Ye, embodies both academic prestige and visionary direction.

Looking ahead, SEP is committed to becoming a catalyst for global scientific advancement and green innovation. Its strategic roadmap for the next decade includes:

1- Global Think Tank Formation - Providing science-based roadmaps for sustainable energy and photonic technologies.
2- Technology Accelerating Program - Bridging academic breakthroughs and industrial applications through pilot projects and industry collaboration.
3- Regional Research Hubs - Establishing SEP centers in Europe, Southeast Asia, and North America to expand its global impact.
4- Youth Talent Incubation - Launching scholarships, fellowships, and international mobility programs for emerging researchers.
5- Sustainability Impact Metrics - Promoting Carbon-efficiency evaluation frameworks to guide low-impact research innovation.

Today, the Society of Energy Photonics stands at the forefront of some of the most urgent and promising scientific frontiers. It empowers a new generation of researchers to harness light, energy, and materials to build a more sustainable, equitable, and technologically advanced world.

From its home-base in Singapore to every region it connects, SEP continues to act as a bridge between nations, disciplines, and generations - where science becomes action, and innovation becomes impact.

Coming soon

Educational Webinar

“Photonic Nanostructures for Solar Cell Harvesters”

by Dr. Nikhil Gupta

Nikhil Deep Gupta is an experienced academic serving as an Assistant Professor at Visvesvaraya National Institute of Technology, Nagpur since May 2018. His main research interests are thin film solar cells and their applications, new photonics materials and devices based on compound semiconductors, display technology, photonic crystals and photonic crystal-based devices. His research group aims to collaboratively solve societal challenges in energy, security, and water for a safe and sustainable future for all.

Save the date: 04 September, 18:30 CET

Click here or scan the QR code to register

In this webinar from the series “This is what I do…”, you will learn about:

- Innovationative photonic nanostructures concept for solar energy harvesters
- Optical simulation methods to improve the performance of nano-textured solar energy harvesters
- Experimental approachs for developing high efficiency solar cells using photonic nanostructures

Published by the speaker:
Periodic Nanophotonic Structures-Based Light Management for Solar Energy Harvesting

Communication 💬 and Engagement

Use our social media platforms: *Facebook*, *Slack*, *LinkedIn*, and email (**TGactivities@optica.org**)
for discussion, information sharing, and event updates

Discussion forums

Click here to join Optica Technical Group on Optics for Energy

Click here to join Optica Optics for Energy Technical Group Chat room

Click here to join Optica Optics for Energy Technical Group