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REVIEW ARTICLE

PHOTONICS: AN EMPOWERING TECHNOLOGY

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Photonics: An Empowering Technology

Dr. Samina Qureshi

Department of Chemistry, Govt. Nehru P.G. College, Agar – Malwa

INTRODUCTION

Photonics is the Science and Technology of generating, controlling and detecting Photons, which are particles of light. These photons are used to advance manufacturing, robotics, medical imaging, next generation displays, defence technologies, biometric securities, image processing, communications, astrology and much more. Light underpins the technologies of daily life, from smart phones, laptops and the internet to medical instruments and LED lighting, those all are possible because of photonics, the 21st century is depend much on photonics as the 20th century depended on electronics. Photonics technology plays a supporting role in several areas of national interest, as well individuals. Below are some areas in which photonics has made an impact.

Information Technology and Telecommunications:-

Today virtually all calls are carried by optical signals and a high speed broad-band internet connection is common. Optical networks represents the infrastructure on which this modern information society is built. This inturn has been allowed and has scaled up with the tremendous advances in several specific photonic components and techniques spanning several multi-billion dollors industries, such as :

- (i) CD's, DVD's, Blue-ray disks,
- (ii) Opticalfibers and fiber components.
- (iii) Semiconductoropto electronic materials
- (iv) The Liquid Crystal Display (LCD) & Light Emitting diodes (LED's)

Health Care and Life Sciences- Biophotonics

The applications of light in health care and life sciences entail several main aspects.

- (a) Light as a diagnostic and monitoring tool.
- (b) Light as a treatment and intervention tool
- (c) Light as a readout tool of Biological samples.

Laser surgery is the cleanest possible tool for a surgical intervention. Optical methods allow fast and cast effective analysis of substances and drugs. Yet it is estimated that till now these known applications of photonics represent less than 20% of all potential application in life science.

Optical Sensing, Lighting and Energy :

- (a) Lighting applications and displays
 - (i) Inorganic and organic light emitting diodes (OLED's)
 - (ii) Electroluminescent lighting
 - (iii) Backing light for LCD's

These devices reduced significantly Electricity Consumption.

- (b) Solar Energy
 - (i) High-efficiency Solar panels for Industrial and domestic applications.

Improvements in photovoltaic cells may permit solar energy to provide upto half of the world energy needs by the middle of the century. These developments will affect the economy globally.

Optics in Manufacturing:-

Optics has had a dramatic economic influence in manufacturing, particularly since the advent of reliable low-cost lasers and laser imaging systems. Optical techniques have become Crucial in semiconductor manufacturing, construction and chemical production. Every semiconductor chip mass produced in the world today is manufactured using optical lithography. Just making the equipment for this business is a \$ 1.0 billion industry and it ultimately enables a \$ 200 billion electronic Business (From U.S. National Research Council Report)

National Defence:- Photonics provide the components and subsystems of the military's most advanced weapons, guidance, communications and

visualizations systems. Night vision imagers and missile guidance units are based on photonics.

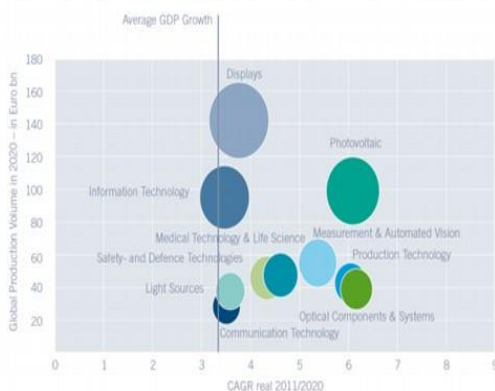
Manufacturing of Optical Systems and Components :

- (i) Optical materials: Glasses, polymers, semiconductors.
- (ii) Nonlinear optical material and nano-optics.
- (iii) Optical components : lenses, mirrors, prisms, beam-splitters, filters, polarisation optics.
- (iv) Micro optics.

Education and Research:-Indeed underpinning the explosive growth of optics and photonics are investments in education and research. Laser was invented in the 1960s, only in 50 years lasers and all the applications they have enabled have completely reshaped the global economy.(Contents from the article by Dr. Cornelly Rablau, Associate professor of Physics and director for the photonics and fiber optics lab at Kettering University. U.S.)

Business in the Field of Photonics:- Business in the field of light-based technologies work on solving key social challenges, such as energy generation, healthy ageing of the population, climate change and security. Photonic Technologies have major impact on the world economy with a current global market of € 300 billion and projected market value of over € 600 billion in 2020.Growth in the photonic industry more than double that of the worldwide GDP between 2005 & 2011. (Source photonic industry report 2013, released by photonics 21. Org)The graph below shows the expected global growth of different photonics segments from 2011 to 2020, and clearly shows that strong segments will continue to grow faster than average GDP.

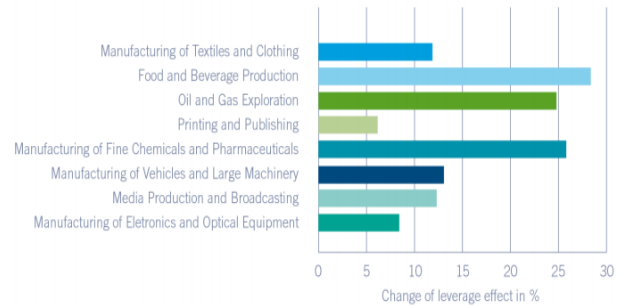
Expected Growth of Global Photonics Segments 2011–2020 compared to GDP Growth



Bubble size indicates worldwide production volume in 2020
 Source: BMBF, SPECTARIS, VDMA, ZVEI (pub.), 'Branchenreport Photonik 2013', Optech Consulting, Study 'Photonik 2013' / Own calculations

The two following bar graphs show the prognosis for the growing impact of photonics on key manufacturing industries and key end-use industries in 2020 versus 2010.

Change Of Photonics' Leverage Effect On Key Manufacturing Industries 2020 vs. 2010



Photonic industries are still very much alive today and sales of optical components are worth around \$ 4 billion, but they form only a small part of the total market for light-based technologies. For example most people in the developed world have some understanding of the \$ 120 billion photonics market, which includes CFL's, LED's & OLEDs. Smart phone provides a good example of the under pinning nature of photonics. The overall economic impact of optics and photonics is two-fold.

- (1) The direct impact stems from the fact that photonic and optics components and systems constitute economic markets in their own right, growing at rates that far super pass the average growth rate of any other areas of the economy.

Much more important is the huge secondary impact, resulting from the use and applications of photonics and optics components, systems, tools and techniques in all sectors of the economy. We could measure the economic impact in the above example by looking as the market size for the lasers, used in smartphones manufacture so we should include the \$ 270 billion smartphones market. The impact of light technologies goes further worldwide revenue from flat panel displays in our T.V. sets, monitors, phones is estimated at \$ 180 billion. The wider economic impact today by photonics is vastly greater. It seem contain that the economic impact of light based technologies will increase in the years to come. We are sure that photonics have a significant impact over Global economy & will grow in future. It is underpinning the daily life of population and making human life easier.