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EDITORIAL

CELEBRATING INTERNATIONAL YEAR OF LIGHT : A CSIR-CGCRI INITIATIVE

If human beings are asked about the most essential things for survival of life on Earth the obvious answer will be "Food, Water and Oxygen". However, if we think about this question more deeply then the actual answer should be "LIGHT" instead. It is the light source from the sun which transforms CO_2 and H_2O into carbohydrate and O_2 by the process known as photosynthesis which is the basis for existence of any form of life on Earth. It will not be an exaggeration if we consider 'light' as our first guide from the very first day of our life as it helps us to see the image of ourselves, people around us and our surroundings. The early man did his activities under day light and then used fire, by burning dry leaves and fire wood, for lighting in the night times. The light also helped them protect against wild animals. With the progress of civilisation, wax candles and oil lamps were used and the real breakthrough in lighting took place in 1879 in the form of incandescent light (IL) source developed by Thomas Alva Edison. The passage of electric current resulted in Joule's heating of the tungsten filament in the protecting atmosphere of vacuum tube and the resultant glow was used for lighting. This produced more heat and only a small portion, about 5% of the energy was converted to light.

The fluorescent lamp technology was developed in late 1930's and it has an improved luminous efficiency and offered about 70-80% energy savings over the incandescent source. These lamps are in the form of linear fluorescent (tubular) and compact fluorescent lamps (CFLs), and can last longer (about 5-10 times compared to the incandescent lamps). Later, the halogen lamp and high-pressure sodium vapour lamp technologies were developed. Their luminous efficiencies and life spans are either comparable or better than that of CFLs, however they are mostly used for outdoor lighting. The path-breaking revolution in lighting started quite recently with the advent of solid state lighting (SSL) in the form of Gallium Nitride (GaN) based bright blue light emitting diodes (LEDs)in the early 1990s for which Isamu Akasaki, Hiroshi Amano and Shuji Nakamura were awarded Nobel Prize in physics in 2014. This diversified the use of light in almost every sector including entertainment, illumination, medical treatment, coding, security, agriculture, communication, education etc. The LED has much higher luminous efficacy and nowadays, the manufacturers

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routinely produce LED bulbs with an efficiency of the order of 100-150 lm/W. Therefore, LED bulbs in place of fluorescent lights (CFLs, tube lights and fluorescent bulbs) can potentially save 50% of power consumption. Also, the LEDs have long life (about 8-10 times compared to CFLs and 50 times more than ordinary filament bulbs), thus require minimal replacements.

LED technology combined with the fiber optic technology has also brought in tremendous difference not only to the lighting but also for the information and communication technologies. Considering the huge impacts light has on the human civilization, the United National General Assembly has decided to celebrate the year 2015 as the International Year of light and light based technologies (IYL 2015). For this purpose several events are being organised throughout the world to commemorate and pay tribute towards the contribution of eminent scientists towards research about light and its development till date and in future.

The CSIR-Central Glass and Ceramic Research Institute (CSIR-CGCRI) has been pursuing intensive research in the area of light technologies by developing different types of optical communication fibers, glass, transparent ceramics, solar harvesting materials and optical coatings for more than few decades. In this aspect, some works from this institution have been incorporated in this latest edition of Science and Culture. A glimpse of the current trends in light related research in CSRI-CGCRI is presented here.

At CSIR-CGCRI, we are celebrating the international year of light by organizing an International Workshop Emerging Areas in Photonics and Future Applications (IWPFA-2015) from 7-12 December 2015. On this occasion, this special issue of the *Science and Culture* is being brought out. The CSIR-Central Glass and Ceramic Research Institute (CSIR-CGCRI) has been pursuing intensive research in the area of light technologies by developing different types of optical communication fibers, glass, transparent ceramics, solar harvesting materials and optical coatings for more than few decades. In this aspect, some works from this institution have been incorporated in this latest edition of *Science and Culture.* Below a glimpse of the current trends in light related research in CSRI-CGCRI is given.

Since the lighting is another vital part of human life and the recent advances in *"Solid State Lighting (SSL)"* are very important to promote energy savings, and reduce greenhouse gas emissions. The article entitled "Solid state lighting" presents an overview of advancements in SSL with focus on GaN light emitting diode (LED), its impact on energy savings and relevance to India. Telecommunication networks across the globe and medical sciences have been revolutionized with the deployment of Photonic crystal optical fibers and this topic is fully covered in the article named "*Wonders of the optical fiber*". The topic "*Trapping of light in natural and artificial photonic crystals, and in hollow core photonic crystal fiber*" explains the work on the trapping of light in hollow core photonic crystal fibers (HCPCF) by mimicking some natural species possessing photonic structures to produce beautiful colours. Bandgap guidance,related properties and designing various photonic structures are also explained with computational photonic.In the article entitled "*High power fiber lasers: fundamentals to applications*", the evolution of fiber lasers in modern era has been described along with the recent activities of CSIR-CGCRI in this field. For high average power and high energy applications at 1 ìm wavelength, it is necessary to use large core active fibers which also reduce the fiber nonlinearity allowing high power scaling. Therefore, large core Double clad fibers are developed to successful design and demonstrate fiber lasers at both 1and 2 ìm regimes. CSIR-CGCRI is the premier glass research institute in the country. Here, the production of new generation optical glasses, radiation shielding glasses, lead-free glasses for use in plasma display devices, chalcogenide glasses and near zero expansion transparent glass-ceramics have been going on over few decades. In the article entitled "*Glass development and production at CSIR-CGCRI for optical applications: some success stories*" a brief outline of the above activities are provided. The enhancement of sunlight conversion into energy is one of the newest topics considering the global demand of energy renovation. Sun light is the most abundant renewable energy source, and the most common device that converts sunlight to electricity is – solar cell. The report "*A revisit on solar cell:*

Generation of electricity by harvesting Sunlight" is a brief review on the development of those solar cells and recent activities of CSIR-CGCRI in the field of solar cell based technologies. In the emerging field of modern advance materials, the ceramics with optical transmission property are capable of contributing towards a wide range of applications. Looking at the varied applications, transparent ceramic materials seem to occupy a major share in the forthcoming market of optical grade engineering materials with priority. Therefore, the theme "*Transparent ceramics*" incorporated in this latest issue deals with the background and latest activities of CSIR-CGCRI in the development of such ceramics with high optical transmission by controlling the formation mechanism of γ-AlON(gama-aluminium oxynitride) and MgAlON (magnesiumaluminiumoxynitride) which could yield prototype samples transparentin region of visible to mid IR electromagnetic radiation range. Finally, the area of optical coatings on glasses and related transparent substrates to control the optical performances, and other surface functionalities is one of the vital aspects related to light technologies. Among various types of coatings, reflective and antireflective (AR) coatings, optical quality scratch-resistant coatings, hydrophobic, colour, non-linear optical and fluorescent coatings are noteworthy. In the article "*Optical coatings*", a brief overview of these above functionalized coatings has been discussed with some representative examples. ❐

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