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EDITORIAL

Eco-friendly Sustainable Multiphase Polymer Systems for Advanced Functions

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When Eric Fawcett and Reginald Gibson discovered polyethylene accidentally, they never realized how useful their discovery will be for mankind, similar to how Charles Goodyear's idea of adding sulphur to polyisoprene would revolutionize the tire and other rubber industries. Although those discoveries centuries ago have never realized their current impact, however, the fact is undeniable on how polymer science has conquered the world, gaining an irreplaceable position from a utilitarian perspective. We are currently bombarded with multifarious polymer compositions which differ on the basis of source, origin, and dimensions. They can be broadly classified on the basis of source as fossil-based and bio-based; depending upon origin as natural and synthetic; and as bulk, micro-and nano-sized based on the dimension of the system. Depending on the constitution and form of the end products, polymers are further categorized as blends, composites, nanocomposites, gels, and interpenetrated polymer networks (IPN) [1].

Polymers have infiltrated almost every industry and are an integral part of our day-to-day lives. Presently, humans are in a place where life without polymers seems impossible. Not only the industries, but the medical sector, packaging sector, personal care, cosmetics, automotive

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and electronic sectors are hugely dependent on the various polymeric products. In the 20th century, the use of plastics had innumerable advantages being cost-effective, easy handling, and wide availability. The blessings of the 20th century however turned into an impending curse on our generation. Depletion of fossil fuels, as well as the excessive use of plastics, damage happening is a red flag for the environment. The widespread use of plastics- a broad term used for non-biodegradable polymers in the food packaging industry has led to serious health issues. Due to the leaching of chemicals into food, disposal issues ultimately lead to either incineration of plastics causing pollution or dumping in landfills or water bodies further damaging the soil and water. Plastics degrade into microplastics which get into the lower strata of the food chain from the aquatic lifeform and finally reach the top of the food chain. Although plastic recycling is an excellent step to encounter, is recycling a solution? Is it even taken seriously? How much recyclable products are undergoing recycling and reuse is a question to ponder?

The alternative is not to put a period on plastics, but to find eco-friendly and sustainable solutions to get rid of the infliction we have created over the years. There are plenty of options to choose from. Over the years several international organizations have taken the initiative to counter plastics. The world health organization in 2019 has called for more research on microplastics and a crackdown on plastic pollution. UNWTO and UNEP have taken an initiative towards Sustainable Development Goals with The Global Tourism Plastics Initiative to unite the tourism sector behind a common vision to address the root causes of plastic pollution. It enables businesses, governments, and other tourism stakeholders on an international platform to lead by example in the shift towards a circular economy of plastics.

With the onset of COVID-19, the already out-of-control plastic problem has intensified with reports stating the generation of more than 8 million tons of pandemic-associated plastic waste globally. Slashing plastics and switching to other sustainable options are needed to preserve our environment and have the resources available for posterity.

Plenty of constructive work is being done towards attaining SDG. A huge mind-shift in research has happened to attain SDG with polymer research accelerating towards environmentally compatible systems. The polymer inherently has different properties. It can stand alone but predominantly multi-component systems are required to achieve an objective. Multiphase systems have been used for generations now. Biodegradable polymeric systems like nanocellulose, lignin, chitosan, carrageenan, PLA, PHA, PBS/A, PCL, PBA/T derivatives have profound applications in industry [2,3] Modification can be brought during copolymerization to tailor according to the need.

The use of different forms of polymer exerts discrete properties serving the requisite functions. In this direction lately, a lot of research is being diverted on lignin. It has been derived from agricultural waste similar to cellulose and is being utilized to produce eco-friendly composites and blends in packaging, biomedical, and energy storage applications [4]. Similarly IPN for hydrogels of PVA and chitosan, gelatin and alginate have shown potential in biomedical applications due to their enhanced elastic and mechanical properties [5,6]**.** Nanocellulose, a potential filler in several composites, blends, and especially in emulsions and other water bases polymer systems, is highly stabilized as a resultant of its unique structural and surface chemistry owing to the presence of numerous hydroxyl groups on its surface which can be functionalized and tweaked as per the requirement[7]. Hence it is considered to be an ideal option for the replacement of toxic additives and property modifiers in nanocomposite materials [7]. Expediting the research in sustainable eco-friendly systems can enable the industry towards safer and greener scientific productions with enhanced functionality, a step ahead to a greener economy.

The phase morphology hence in various multicomponent polymer-based systems governs the physical characteristics allowing control over material designs and development of new polymeric systems. The recent advances concerning morphological, rheological, interfacial, physical, fire-retardant, thermophysical, and biomedical properties of multiphase polymer systems have a beating over the non-eco-friendly counterparts. Advanced applications with enhanced physical, mechanical, thermal, electrical, magnetic, and optical properties are undertaken with a step closer towards the green economy.

Ideas should be brought forth to create eco-friendly sustainable polymers systems which can change the concept of classifying every polymer as “the plastic” and eradicate this negative terminology associated with polymers in the mind of commoners.

The objective of this special issue is to create a common ground for the discussion of eco-friendly sustainable technologies incorporating multiphase polymer systems. The present issue is to survey the recent developments in such green systems covering the actual scientific synthesis procedure, incorporating characterization and identification of different physical, chemical, interfacial and thermophysical properties as well as encompassing the headway achieved in this area. All the recent scientific advancements in the field of green, sustainable multiphase polymer systems are anticipated to share their work to put forth a special issue which can strengthen the core of the scientific community to work towards Environment Sustainable Technologies.

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