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Sustainable routes to highly flame retardant polyurethanes

In 1937, Dr. Otto Bayer's first discovery of polyurethanes by a polyaddition reaction of polyol and diisocyanate showed a polymer with interesting properties. Since then, polyurethanes made their way towards eminent success in fields of construction, furniture, appliances, thermal and electrical insulations, packaging, automobiles, aerospace application and many more. However, high surface to volume ratio and hydrocarbon-based overall composition makes polyurethanes vulnerable to fire hazards. Based on National Fire Protection Association about 1.34 million fires resulted in deaths of 3,390 civilian and property loss of about $10.6 billion in 2016. Rigid polyurethane foam is one of the major constructional and electrical insulation material with potentials of fire issues. This talk will be focused on synthesis and characterization of flame retardant polyurethanes using novel reactive phosphorous based flame-retardant and polyols from renewable resources. Utilizing bio-based polyols for the synthesis of polyurethanes will promote sustainability towards depleting petroleum resources. Polyurethane foams having a various weight percentage of phosphorous were prepared. It was observed that use of reactive phosphorous based flame-retardant in polyurethane foams showed improved compressive strength without affecting closed cell content and morphology of the foams. The horizontal burning test showed a drastic reduction in self-extinguishing time and weight loss for the polyurethane foams containing reactive flame-retardant. For example, castor oil and reactive flame-retardant based PU foam which contains 1.5 wt% P showed 98.2% and 93.8% reduction in self-extinguishing time and weight loss, respectively with respect to the foam without flame-retardant. Cone calorimeter data also showed a significant reduction in peak heat release rate, total heat release, total smoke release, and overall smoke production rate for the foam containing 1.5 wt% P compared to 0 wt% P in the foam. The details about the fire-retardant mechanism and other results will be presented.

Biography

Ram Gupta is an Assistant Professor of Chemistry at Pittsburg State University, USA. Dr. Gupta's research focuses on green energy production and storage using conducting polymers and composites, nanomaterials, optoelectronics and photovoltaics devices, organic-inorganic hetero-junctions for sensors, nanomagnetism, bio-based polymers, bio-compatible nanofibers for tissue regeneration, scaffold and antibacterial applications, bio-degradable metallic implants. Dr. Gupta published over 175 peer-reviewed journal articles, made over 150 national/international/regional presentations, chaired many sessions at national/international meetings, and received over 1 million dollars for research and educational activities from external agencies such as NSF, DoE, KINBRE. He is serving as Associate Editor and editorial board member for various journals.

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