Vernon T Mbah, J Chem Eng Process Technol 2017, 8:4 (Suppl)
DOI: 10.4172/2157-7048-C1-006

Cellulose acetate-graft-poly(methyl methacrylate): A "graft from" approach of nitroxide mediated radical polymerization (NMP)

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Synthetic polymers which represent essential functional materials for everyday use, are mainly produced from fossil sources. They are inherently non- biocompatible and non-biodegradable, and therefore pose huge environmental issues. Additionally, these sources are non- renewable and may be depleted after several years. Recently, biodegradable, biocompatible and environmentally benign graft polymers from renewable sources have been successfully synthesized through conventional techniques. However, controlling the polymer size and structure is a challenging task. Orientation: Cellulose acetate-methyl methacrylate copolymer was obtained through a three-step process via the Nitroxide Mediated Polymerization (NMP) process. Firstly, the hydroxyl groups of cellulose acetate (substrate) were functionalized with a bromoisobutyryl group. In the subsequent step, the SG1 nitroxide was coupled to such an intermediate to form a macroalkoxyamine, exploiting the formation of a copper/ligand catalyst which promotes the displacement of a bromide atom from the α-bromoisobutyryl moiety. Finally, the resulting alkoxyamine was thermally decomposed in the presence of methyl methacrylate (monomer) to form a copolymer through a typical NMP mechanism. In fact, at 95°C, the carbon centered radical thermally formed by the alkoxyamine decomposition was able to attack the monomeric units producing radicalic propagating chains. At the same time, such a decomposition releases SG1 nitroxide units, able to couple with these chains yielding larger and larger macroalkoxyanines which, in turn, could decompose following the same mechanism, with the continuous formation of radicalic polymer chains. This system is usually able to control the molecular weight distribution and polydispersity, hence the size and structure of the resulting polymer. By acting upon the reaction time, it is possible to get polymeric chains with retention of the "living" character, with the possibility to obtain more architectural designs. Findings: FTIR, NMR, as well as DSC analysis confirmed the formation of this kind of copolymer, and the corresponding living character has been assessed by means of EPR spectroscopy. Conclusion & Significance: Biodegradable polymers with controlled sizes, structures and different architectural designs can be synthesized from renewable resources by NMP, which in turn represents a "greener" approach with respect to the conventional methods. In this way novel, cheap and ecofriendly polymeric materials with extensive applications can be produced.

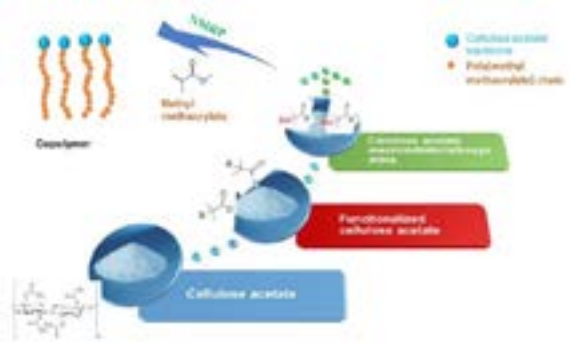

Figure 1: Nitroxide mediated radical polymerization of cellulose acetate-graft-poly(methyl methacrylate)

Biography

Vernon Tebong Mbah is a chemical engineer investigating the design and synthesis of polysaccharide based polymers using nitroxide mediated radical technique. He is a second year PhD student at UNIVPM in SIMAU department with an extensive understanding in material science and engineering. The chemistry research group at SIMAU department has long years of experience in free radical chemistry, and Vernon Tebong Mbah also possesses several years of research experience in inorganic materials synthesis. His research is aimed at producing varieties of cheap environmentally friendly materials for daily uses through greener processes.

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