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Radiation-Induced Admicellar Polymerization of Methyl Methacrylate on Cassava Starch

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Cassava starch (CS) is a natural polymer that is inexpensive and abundant, especially in Thailand. In addition to being cost-effective, CS is also biodegradable, compostable, non-toxic and most importantly renewable. Consequently, blending CS with other biodegradable synthetic polyester such as poly(lactic acid) (PLA) is economically interesting, due to a high potential of cost reduction as well as biodegradability of their blends. Nevertheless, it is very difficult to blend starch with other synthetic polymers, due to their incompatibility. Several research groups reported their attempt to improve the compatibility between synthetic polymers and starch using different techniques. Among these available methods, the modification of starch surface by admicellar polymerization is rarely investigated. Admicellar polymerization offers several advantages over traditional techniques. Accomplished in aqueous solution, this environmentally friendly technique can form nanoscale polymeric thin films, with minimum chemical usage and without the use of organic solvents. Additionally, this benign technique is able to maintain basic properties of the original material. Admicellar polymerization is applied to induce surface modification to make two components of their polymeric composites more compatible. Applications of admicellar polymerization are numerous, from reinforcements of composites to value addition of functional textiles. These examples emphasize the advantages of using admicellar polymerization as an effective method to enhance compatibility between a filler and a polymer matrix, which ultimately leads to improved mechanical properties of their composites. Our recent work has proven that admicellar polymerization, induced by thermal process, can be successfully applied to coat the surface of starch with poly(methyl methacrylate) (PMMA) to render it more hydrophobic and more compatible with PLA. The objective of this research is to further expand our previous study by applying gamma radiation to induce admicellar polymerization. The third step of admicellar polymerization is traditionally induced by thermal process, with chemical initiators. However, radiation process requires no catalyst to initiate the reaction, thus resulting in contamination-free products. In this study, methyl methacrylate (MMA) is used as a monomer for the formation of ultra-thin PMMA film on the surface of CS. Surface modified CS is characterized by iodine test, floatation test, film formation analysis, Fourier transform infrared spectroscopy (FTIR) as well as thermal gravimetric analysis (TGA). The comparison is made between cassava starch modified by radiation process (RS) and thermal process (TS). Results from film formation analysis, FTIR and TGA indicate that RS shows higher percentage of PMMA film formation than TS, hence confirming that radiation processing can be applied as an alternative method for surface modification through admicellar polymerization.

Country/Organization invited to participate

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