MATERIALS SCIENCE AND ENGINEERING

SEMINAR

"Development of Pickering Emulsion Polymerizations Stabilized by Cellulose Nanocrystals (CNCs) for the Manufacture of Polymerized Toners"

By

Youngman Yoo

Purdue MSE Preliminary Exam

Advisors:
Professor Jeffrey Youngblood

ABSTRACT

In light of global warming, environmental issues have received much attention in all areas. Chemically produced toner (CPT) processes enable reduction of size distribution and shape control of toner particles required for better print resolution and energy-saving features. A Pickering emulsion polymerization method for the manufacture of CPTs will be presented in this paper. The oil phase, containing a styrene monomer, divinyl benzene, plant oil based acrylate derivative, 2,2'-azobis(isobutyronitrile), polyethylene wax, and carbon black, is dispersed in the water phase. To stabilize the emulsion, Pickering emulsion uses colloidal particles instead of surfactant molecules. The aqueous phase contains amphiphilic, rod-like shaped and sustainable cellulose nanocrystals (CNCs) as emulsion stabilizers. The size distribution and shape of toner particles will be evaluated by a particle analyzer and a scanning electron microscope (SEM). The thermal properties of the toner samples will be evaluated by differential scanning calorimetry (DSC). The toner, having a plant oil derived acrylate-styrene resin, will be compared with a control toner containing a typical styrene-butyl acrylate resin to examine the effect of a long aliphatic chain on the performance characteristics of the toner, including total volatile organic compounds (TVOC) emission level, fusing window, and image quality. The role of a long aliphatic chain as an intramolecular plasticizer in a toner will greatly extend the fusing window by reducing its lowest fusing temperature (LFT) without worsening its hot offset temperature (HOS). However, the introduction of a long aliphatic chain to a styrene resin and the subsequent decrease in its glass transition temperature (T_g) might cause a problem with storage stability and durability of the toner. This problem can be solved by a coating of highly crystalline CNCs with a high mechanical strength and toughness via the Pickering emulsion process. The effect of a thin CNC coated film on the durability, flow-ability, and storage stability of toners will be examined by comparing change in particle size distribution before and after a glass bead shaking test, examining the resistance to powder flow, and checking the degree of agglomeration of toner powder at 50 ℃ for 48 h. The use of the Pickering emulsion polymerization stabilized by CNCs for the preparation of CPTs not only leads to an increase in durability, flow-ability, and blocking resistance of toner particles, but also improves image quality without lowering other desirable performances such as fusing ability and electrostatic surface charge of toner particles, and anti-vinyl offset of printed paper sheets.

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