

Title: Nanocomposite Coatings from a Facile Exfoliation-Reassembly Process

Background; Facile exfoliation is defined as the dispersing of layered-sheets of material on the nano-scale and re-assembly involves the ordered assembly of dispersed sheets with a matrix-polymer in-between the sheets forming a nano-composite material with advantageous new properties such as enhanced thermal, mechanical and flame retardancy capabilities.

Nano-coating processes such as the ‘layer-by-layer’ (LBL) but exhibit some limitations. For example, LBL assembly process involves a lot of repeated steps to build a film thickness on a substrate. In one referenced paper, a thin film of thickness 5 nm (10-9m) took more than 2 days to form. LBL and other nano-composite methods tend to be highly labor intensive, time-consuming processes that lead to high cost. This is not the preferred method for a commercial application.

Benefits: This exfoliation-reassembly process involves the dispersion of a layered compound, introduction of a polymer matrix in an aqueous solution (water as a solvent in some cases) and finally co-assembly of the exfoliated individual single layer nano-sheets with the polymer matrix onto the substrate. As the single layer nano-sheets re-assemble, alignment can be guided by either gravity or a mechanical/shear force exerted by common industrial processing rolls. If needed, the aligned nano-sheets can be cross-linked with the polymer matrix, to solidify the nano-coating. The final nano-coating will possess significantly improved mechanical and barrier properties as well as flame retardancy.

Market Potential/Applications: Nano-composite materials possess valuable properties such as excellent barriers to moisture and gases, superior mechanical properties, thermal stability and improved flame retardancy. The packaging and motor-vehicle industries are two major markets for nano-composites, accounting for almost 50% of the market demand. Key packaging applications include soft-drinks, beer, food and pharmaceuticals due to the improved barrier properties and strength. Construction will also begin to utilize nano-composite materials by replacing fiber-reinforced plastics in a number of applications.

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Licensing Contact Information: Reddy Venumbaka, Ph.D., Director, Office Technology Commercialization. Tel; (512) 245-2672, e-mail: reddy@txstate.edu.