Inorganic Nanosheets and Nanosheet-Based Materials: Fundamentals and Applications of Two-Dimensional Systems

Applications of Nanoclay-Containing Polymer Nanocomposites

Bandyopadhyay, Jayita; Ray, Suprakas S

Abstract
In 1989, a report from the Toyota Central Research and Development Laboratory on the synthesis of nanoclay-containing polymide nanocomposites using in situ polymerization opened a new era for polymer nanocomposites (PNCs) [1]. PNCs provide several significant advantages over traditional polymer composites. To impart the desired mechanical or thermal properties, conventional composites usually require a high filler loading (usually 10-50 wt%), whereas the same or even better performance can be achieved with PNCs at a much lower nanoclay loading (usually 3-5 wt%) [2]. Hence, it is possible to develop high-performance and lightweight polymeric materials using PNC technology. Over the last two decades, severl journal articles, conference proceedings and patents have been published on the preparation, characterization and properties of PNCs covering almost all polymer matrices: however, the commercialization of PNCs was harder than initially anticipated. In the early 1990s, a first attempt was made to introduce PNC-based components in Japan. The idea was soon abandoned due to cost-competiveness [2]. However, the past few years have provided key breakthroughs in nanocomposite technology. The announcement by General Motors (GM) that they were introducing polypropylene (PP)/clay nanocomposites to fabricate the step assist in two of their 2002 mid-size vans was a milestone in the commercialization of PNC technology. The PP/clay nanocomposite part used in GM vans was the first commercial product resulting from fundamental developments [2]. Lloyd and Lave reported that the demand for new and advanced materials in automotive applications continued afterwards for vehicle safety, performance and fuel efficiency [3]. The authors also mentioned other applications using nanoclays including underground piping and packaging.