고분자 나노 소재의 응용 및 연구 현황

박영준

서울시 서대문구 신촌동 연세대학교 나노 특성화 사업단

Polymeric Nano-materials: Applications & Research Trends

Young-Jun Park

Yonsei Nanotechnology Research Center, Yonsei University, Seoul, Korea

The fabrication, characterization and manipulation of nanosystems brings together physics, chemistry, materials science and biology in an unprecedented way. Phenomena occurring in such systems are fundamental to the workings of electronic devices, but also to living organisms. The ability to fabricate nanostructures is essential in the further development of functional devices that incorporate nanoscale features. Even more essential is the ability to introduce a wide range of chemical and materials flexibility into these structures to build up more complex nanostructures that can ultimately rival biological nanosystems. In this respect, polymers are potentially ideal nanoscale building blocks because of their length scale, well-defined architecture, controlled synthesis, ease of processing and wide range of chemical functionality that can be incorporated. In this presentation, we will look at a number of promising polymer-based nanofabrication strategies that have been developed recently, with an emphasis on those techniques that incorporate nanostructured polymers into devices and that exploit intrinsic polymer properties.

Nano-structured Functional Polymeric Particles

Functional nano/microspheres deliberately designed using several powerful process methods and their application will be discussed. Nano-structured nano/microsphere, what we called, implies dispersed polymeric colloids with the size ranged from several nanometers to thousands of nanometer. They

have extremely large surface area, thus it is very important to control the morphology or surface functionality fitted for adequate objectives and properties. Their properties should be controlled for various kind of bio-related technologies, such as immunomagnetic cell separation, drug delivery systems, labeling and identification of lymphocyte populations, extracorporeal and hemoperfusion systems, etc. Well-defined polymeric nano or microsphere can be considered as smart bomb or MEMS.

Hyperstructured Polymeric Materials

Many kinds of hyperstructued organic materials for industrial application are probably the class of materials with the widest variety of functionalities. Today the term hyperstructred organic material encompasses a wide range of products such as displays, fuel storage, electronic devices and interconnect materials for semiconductor etc. The development from the material study to the marketplace has taken in all cases many years. However, many problems are still open, some of them fundamental others more technological. In this study a review of the present status of the hyperstructured organic materials will be given, together with a discussion of the major issues facing the industry. We have studied for many years about hyperstructured organic materials like nano-porous P/F polymer particles, polycarbonate nano-particles and low dielectric constant materials using the advanced technology. Polycondensation is not a novel process, however, it can be utilized to synthesis of nano-structured latex particles. It was an object of the present proceeding to produce condensation polymers in the form of nano-sized particles by new process, which is capable of alternating the existing process, which requires very high temperature and vacuum to allow the removal of the condensate molecule from the polymer melt. Nano-sized porous polymer particles are applied to a thermal insulator for electronic materials and a supercapacitor for electric cars. We also prepared high molecular weight PC nano-particles using transesterification between bisphenol-A (BPA) and diphenyl carbonate (DPC) in supercritical CO_2 which is an excellent plasticizing agent and a good solvent for phenol, by-product of the reaction. The porous thin film with a low dielectric constant for interlayer

dielectric applications in microelectronics is essential that the layer maintain its specific electrical, physical, and chemical properties after incorporation in the device structure and during subsequent processing.

Polymers for Electronic Materials

Many kinds of materials for electronic application are probably the class of materials with the widest variety of functionalities. Today the term electronic materials encompasses a wide range of products such as displays, nanotubes for electronic devices and interconnect materials for semiconductor etc. Several research groups around the world have succeeded in fabricating display systems and electrical switches such as the field-effect transistor from single-walled carbon nanotubes. The development from the material study to the marketplace has taken in all cases many years. However, many problems are still open, some of them fundamental others more technological. In this study a review of the present status of the electronic materials will be given, together with a discussion of the major issues facing the industry. It also offers a forecast of the future of electronic materials in terms of their chemical engineering. We have studied for many years about electronic materials like conducting composite balls, low dielectric constant materials and nano-porous polymer particles using the advanced technology. Until now, metal ball and polymer/metal composite particle have been greatly used for conducting adhesive as the microelectronic materials. But they have some defects like, easy-short, phase-separation etc. Polymer/metal/polymer 3-layer composite particles for conductive adhesive were developed to overcome these defects. The porous thin film with a low dielectric constant for interlayer dielectric applications in microelectronics is essential that the layer maintain its specific electrical, physical, and chemical properties after incorporation in the device structure and during subsequent processing. Nano-sized porous polymer particles also are applied to a thermal insulator for electronic materials and a supercapacitor for electric cars.