Invited Lectures 3

Multicomponent Nanostructured Materials for Separation Membranes

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Under the coordination of GKSS a new European project in the field of membrane development started recently. This project focuses on the development of novel nanostructured materials for selective material transport and separation. Two classes of materials will be developed in this project: nanostructured organic/inorganic hybrid materials and functional self-organized supramolecular copolymers. One class of materials, which will be discussed in this lecture are mixed matrix membranes. An example are hybrid materials made from polymers and carbon molecular sieve particles. The influence of size and geometrical form of the molecular sieve particles on permeability will be explained, especially mixed matrix membranes containing aligned flakes with high aspect ratios have superior properties. It will be shown further, that the addition of impermeable particles to a polymer may result in unexpected changes in transport properties. Inorganic/organic composite structures with domain sizes approaching the nanometer scale show in many cases unexpected behaviour. The properties of these materials are not just the sum of individual contributions from both phases. As the inner interfaces become dominant, polymer properties like density, glass transition temperature and fractional free volume may change in the interface region leading to a change in transport properties.

Another class of potentially attractive membrane materials are based on self-assembly of polymeric supramolecules. Self-organisation of block copolymers gives rise to nanostructured material and functionalities. The use of intermolecular repulsing and attraction forces provides a rational and efficient method for positioning molecular components precisely in a well defined supramolecualr architecture. This research may lead to totally new methods for preparation of functional materials with very high transport selectivity.