Charles Linder
Research Interests and Activities

Self assembled nano particles for drug delivery

I am involved in several projects on targeted drug delivery with my colleagues Profs Sarnia Grinberg and Eli Heldman using self assembled nano particles that we have developed over the last eight years. The nano particles are based on bolaamphiphiles (two ionic head groups connected by an aliphatic chain) that self assemble into multifunctional nano-vesciles for controlled drug delivery. The multifunctionality of nanoparticles needed for efficient drug delivery into the brain are 1) high encapsulation efficiency, 2) stability, 3) penetration through biological barriers, 4) targeting and 5) controlled release at target sites. This work has resulted nano particles with many of these properties which is documented in more than twelve papers and five patents. One outstanding and unique feature of these nano particles is their ability to carry small, molecules, and macromolecules such as peptides, proteins and polynucleotides (DNA and RNA) into the brain after oral or intravenous administration We are now involved in the following projects to demonstrate the efficacy of these platforms: a) Delivery of the protein glial derived neural factor (GDNF) to the brain by nanovesicles for the treatment of Parkinson's disease. This work is sponsored by the Michael J Fox Foundation. b) For the treatment of brain tumors (GBM) we are studying the delivery of Tenofovir to the brain, in a project sponsored by the Campbell Foundation. c) To learn more of the actual mechanism as to how our nano vesicle particles pass the blood brain barriers and delivery drugs to the CNS, we have won an Israel Science foundation grant, with Dr David Stepensky, for such a study. The knowledge we are gaining on the self assembly of nano particles with controllable multifunctionality, besides being applicable to drug delivery could have significant applications in other fields such as membranes, catalysis and material science which we are now looking into.

Membrane development for water and industrial applications

In a project with Professor Yoram Oren we are studying the supramolecular aggregation of polymer mixtures into NF and RO membranes by combining phase inversion together with polymer separation. A current major activity is to understand the material parameters and conditions of phase inversion and polymer-polymer separation to transform by self-assembly a homogenous solution of incompatible ionomers and hydrophobic polymers into a composite asymmetric NF or RO membrane with controllable morphologies and flux rejection characteristics. From a scientific aspect we are formulating a relationship between the conditions of preparation, solubility/interaction parameters of the polymers, solvents in the casting solution, coagulation bath and annealing conditions with the resulting membrane morphologies and performance. It would be a significant advance in the field of membrane technology in many applications to achieve cost effective robust NF and RO membranes with high flux, good selectivity equal to the current polyamide composites but with much better chemical stability. Inexpensive robust NF and RO membranes would find many water treatment applications in developing countries where current membrane systems needing extensive pretreatments and membrane replacement are too expensive. The uniqueness to polymer science of this work is that complex structures with controlled morphology can be used to make reproducible multifunctional films by the bottom up approach of self assembly whose practical application in this proposal is limited to membranes. Thus this work will contribute to a better understanding as to how solvent polymer interfacial forces and polymer-polymer interaction forces can be used to control final morphology with general applicability to the field of polymer blends.