The use of molecularly designed materials: peptide amphiphiles (pa) and elastin-l...

Science, Chemistry

The first materials that were available come from nature. With time, the use of available synthetic materials started to increase and from the 1960’s up to now designed materials were introduced. In the last two decades there has been a resolution of molecularly designed materials. The emphasis lies on the transition from sophistication to functionality. This would mean from peptides, to recombinant proteins, to dendrimers to proteins.

Peptide amphiphiles (PA) are molecules that consist of two parts, namely a hydrophobic and a hydrophilic part. These PA molecules are charged and the end result are nanofibers and bioactive gels that can mimic the extracellular matrix. In order to test the functionality of PA, these materials were tested in rats. These tests concluded that PA molecules actually formed very weak gels meaning that materials that are stronger needed to be developed. A current on-going project makes use of PA molecules for osteocyte development.

Elastin-like proteins (ELPs) have a bioactive modular structure and are thermos responsive meaning that they can change their conformation. Statherin peptides can be found in saliva and are acidic Pro and Tyr rich. They also have a high affinity for HAp (N-terminal-Glu). These Statherin peptides are very active osteocytes promoters in non-osteogenic media.

Nanocrystals grow on surfaces in a hierarchical form, this resembles the center of a volcano. A coated membrane is formed once they have stopped growing. If the way in which these nanocrystals grow can somehow be manipulated, different types of membranes can then be developed. The next step was then to develop and implement nanocrystals that are able to grow in tissues e. g. enamel-like structure. The goal was then to fine tune these nanocrystals in order to be able to grow human dental enamel in the future.

The self-assembly capacity of nanocrystals can be combined with the regeneration properties of PA molecules. As PA is positively charged and ELP is negatively charged, when both come together an ELP/PA membrane is formed. By injecting a PA drop in an ELP solution, a closed sac is obtained that resembles an ELP/PA tube.

This process is called morphogenesis into tube where a solid-state conformation is changed to an open conformation. This is called self-assembly were particles organized themselves into fibers that are grouped. By adding more solution, the tube will increase in size. By manipulating the way in which this process takes place, many different types of tube like self-assembling capillaries can be developed. These applications have a potential use for tissue engineering.