含醣類團基之液晶分子之自組裝奈米結構研究

學生 ： 宋建宏　　指導教授 ： 許千樹 博士

國立交通大學 應用化學研究所 博士班

摘要

本論文係探討三類含葡萄醣之液晶化合物在溶液中所形成之奈米結構。利用沉澱之方法，這些化合物在溶液中經由液晶相會彼此聚集最後形成各式各樣之超分子結構，這些液晶分子皆含有親水性葡萄醣基及schiff-base 液晶基及長烷鏈末端，隨著末端烷鏈長度之增加，這些液晶化合物在水中其形態會逐漸由板狀變成螺旋緞帶結構，根據理論預測及實驗結果證實，旋光性醣基之扭轉力道係由末端烷基之長短來決定，此外，若在液晶基之苯環上引入另一長烷基，則此化合物在水溶液中會生成新的囊胞球殼狀結構。

本研究第二部分係在末端烷基上導入一 ferrocene 團基，由於巨大ferrocene 團基導入，此兩性液晶化合物在水溶液中，則形成電纜線狀奈米結構，由穿透式電子顯微鏡圖可以看出，每一奈米管中埋有緻密的黑色線條，由此結果可之 ferrocene 中之鐵原子皆被排列在奈米管之內層，當利用高磁場來排列此含 ferrocene 之兩性液晶化合物，其則會長成有方向性之樹枝狀結構。

最後本研究則在兩性液晶末端烷基上導入紫外光可聚合之cinnamate 團

基，在水溶液中，此液晶化合物仍然會形成螺旋狀之緞帶結構，可是由於此巨大 cinnamoyl 團基之導入，此緞帶會由原先的左旋變成右旋之緞帶，若經紫外光聚合，所形成之奈米結構可以因此固定，而且其機械性質也會因此增加。

Study on Self-assembled Nanostructures of Glucose-containing Liquid Crystals

Student：Chien-Hung Sung Advisers : Dr. Chain-Shu Hsu

Department (Institute) of Applied Chemistry

National Chiao Tung Univeristy

Abstract

Self-assembled nanostructures formed in solution state by containing liquid crystals were investigated in this study. A series of novel organic superstructures revealing diverse aggregate morphologies with liquid-crystalline-like properties were prepared by a simple precipitation method. Here, a chiral sugar moiety was simply introduced to the Schiff-base rod end of rod-coil molecules. In contrast to coil-coil molecules, the self-assembly rod-coil molecules possess strong segregation strength for phase separation due to their liquid-crystalline-like behavior. The morphological transformation of self-assembled chiral Schiff-based rod-coil amphiphiles, from platelet-like morphology to helical twists, was obtained by increasing the length of hydrophobic tail. Consistent to theoretical predictions, the bending force from chiral entity is dependent upon the size of the adjacent hydrophobic tail. Namely, the size of hydrophobic chain determines the threshold of bending for the formation of helical morphology. Moreover, self-assembled spherical vesicle can be obtained by introducing an additional tethered hydrophobic chain due to the collapse of twisted shape.

Furthermore, a ferrocene group was introduced to the hydrophobic end of chiral Schiff base liquid crystals. Instead of helical-twist morphology, this ferrocene containing rod-coil amphiphile forms a kind of cablewire-like nanotubes morphology. Its TEM image shows numerous fine and parallel aligned black lines imbedded in the nanotubes. This means that iron atoms of ferrocene groups are located in the inner side of each nanotube. When these ferrocene-containing liquid crystals are aligned under a strong magnetic field, it will form the aligned dendritic morphology.

Finally, a UV-curable cinnamonyl group was introduced to the hydrophobic end of chiral Schiff-base liquid crystals. This cinnamoyl-containing rod-coil amphiphile forms again a helical-twist morphology. However it shows a right-handed helical twist which is completely different from the first series of chiral Schiff-base rod-coil amphiphile. It means the big hydrophobic end will change the helical twist direction of the nano-ribbon. After UV exposure, the formed nanostructure can be fixed and its mechanical strength is greatly enchanced.