Chapter 15

DESIGN AND FUNCTION OF LOW MOLECULAR-MASS ORGANIC GELATORS (LMOGs) BEARING STEROID AND SUGAR GROUPS

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1. Introduction

Steroids and sugars are well-known examples of low molecular-mass organic gelators (LMOGs). Although, they have been used and investigated...
as naturally occurring molecules for many years, the discovery that some are LMOGs was made serendipitously and only a couple of decades ago. Since that time, chemists have designed many LMOGs and have transformed some of their gels into functional materials. The most important objectives of this chapter are: (1) to present the historical development of the above two series of gelators from the standpoint of the relationship between their molecular structures and their aggregate structures in gels and (2) to indicate some of the functions and applications of these gelators that arise, in part, because of the biocompatibility of sugars and steroids.

2. Steroid Derivatives for Gelating Organic Liquids

2.1. Introduction

Steroids are a class of naturally occurring molecules that are lipids. They exist in all plants and animals and play important roles to control biochemical activities associated with life. The molecular structures of steroids are composed of a complicated tetracyclic androstane skeleton (with A, B, C and D rings) which defines the characteristics of steroids. The connective carbon atoms of the fused ring systems generate cis or trans configurations at each stereocenter. All-trans isomers of plural fused rings are most commonly found. They result in somewhat planar and rigid structures. Thus, derivatives of the common steroid, cholesterol, tend to form mesophases in which steroid-sterol stacking, mainly from van der Waals interactions, results in long-range, one-dimensional (1-D), helical structures. 1-D aggregate growth is a prerequisite for the gelation to occur in most known cases.

2.2. Structural Variations of Steroid-Based Gelators and their Analyses

In the early 1960s, some steroidal derivatives (such as deoxycholic, cholic, apocholic, and lithocholic acids, as well as their salts) were found