Cholesterol-based supramolecular plastics with a hierarchical structure

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In response to the pressing issue of plastic pollution, plastic reduction policies have been enacted globally. Despite these efforts, the annual production of plastic waste is still predicted to increase.[1] Supramolecular plastics, with their dynamic and reversible bonding natures, have emerged as a promising and sustainable solution to this problem.

In this study, we investigated the formation of free-standing supramolecular plastic films using naturally occurring cholesterol derivatives, which is well known to show one-dimensional self-assembling properties.[2-3] We designed and synthesized cholesterol-derived carbamates with three different alkyl chains to control their intermolecular interactions and hierarchical structures: Cholest-5-en-3β-yl *N*-hexyl carbamate (**C6**), Cholest-5-en-3β-yl *N*-dodecanoyl carbamate (**C12**), and Cholest-5-en-3β-yl *N*-octadecyl carbamate (**C18**). The process of the supramolecular plastic films is demonstrated in **Figure 1**. Each compound was melted at 100 °C and quenched into chunks at varying temperatures (room or cryogenic temperature). Subsequently, these chunks were pressed to form supramolecular plastic films using hydraulic pressing (0 to 98 kN) at room temperature. The length of the alkyl chains of the compounds significantly impacts the processability and mechanical properties of films.

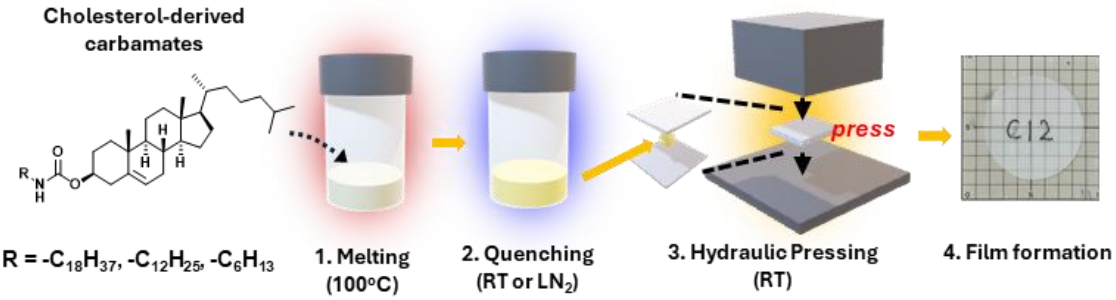

Figure 1. Chemical structures of cholesterol-derived carbamates (**C6**, **C12**, **C18**) and a schematic diagram of formation of a free-standing supramolecular plastic film

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