



# The correlation of microstructure morphology with gelation mechanism for sodium soaps in organic solvents

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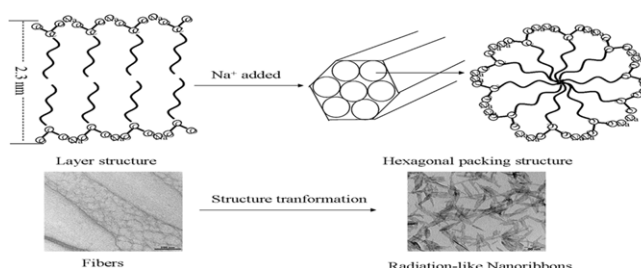
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## HIGHLIGHTS

- ▶ Sodium soaps can form radiation-like gel fibers in organic solvents.
- ▶ Na<sup>+</sup> plays a key role in gel formation and microstructure morphology.
- ▶ Na<sup>+</sup> induces structure transformation from fibers to nanoribbons.
- ▶ These are produced by Na<sup>+</sup>-inducing packing change of sodium soaps.
- ▶ Layer to hexagonal packing transformation is the reason of gel formation and morphology change.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Using sodium caprylate as a model molecule, in the present work, we unraveled the gelation mechanism of sodium soaps in organic solvents from its correlation with the microstructure morphology. It is interesting to find that both the formation of organogels and radiation-like gel fibers are controlled by Na<sup>+</sup> concentration in the system. As the gel-activator, the sodium ions not only accelerate the gelation process and enhance the gel networks, but also induce the morphology transformation from fibers to radiative nanoribbons. TEM and XRD characterization reveals that the Na<sup>+</sup> enhanced effect should be ascribed to the structure transformation of sodium caprylate from layers to hexagonal packing, due to its reduced inter-separation after the addition of Na<sup>+</sup>. Based on these results, the gelation mechanism of sodium soaps has been also proposed.

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## 1. Introduction

As one of the most important soft matters, organogels formed by the gelation of low-molecular-mass organic gelators (LMOGs) in organic solvents have attracted enormous interests in recent years, due to their abundant structures and novel functionalities [1–7]. It is widely acknowledged that the formation of organogels is a process driven by non-covalent interactions of the gelators with solvent molecules, such as van der Waals, H-bonding, and  $\pi$ – $\pi$  stacking forces, and the change in molecular interaction forces can generate a shape transformation from fibers to helical fibers,

spheres, and branched structures [8,9]. In the previous report, we also found that the enhanced H-bond interactions between primary alkylamine and ethylene glycol can lead to the shape change from vesicles in sol state to interconnected-fiber gels [10]. Based on sol–gel transformation process, a few theories, including crystal mismatching branched mechanism, etc. [11] have been developed to explain the formation of these various microstructures. However, to explain the gelation mechanism from the viewpoint of microstructure analysis still remains a challenge. The relationship between gel morphology and its formation mechanism is still far from clear. These have greatly handicapped the further technological and scientific development in this field.

Sodium soaps, one of the conventional surfactants, have been widely applied in industrial process and daily life, and also their abilities to jellyfy water and alcohols are well known [12,13].

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