# Kinetic control of a nucleophilic reaction in reverse wormlike micelles by modulating alkane chain length

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Reverse wormlike micelles (RWMs) are soft confinement model systems that act as anisotropic nanoreactors, providing a versatile platform to investigate how confinement influences the efficiency of chemical reactions in aqueous media [1]. Among these, nucleophilic addition reactions remain largely unexplored despite their relevance to a wide range of chemical and biological processes, including enzyme-catalyzed hydrolysis [2]. As a proof of concept, this work investigates the influence of the structure of RWMs composed of lecithin, water, and different linear alkanes (octane, C8; nonane, C9; decane, C10; and undecane, C11), at a fixed water-to-surfactant molar ratio ($W_0$), on the kinetics of the nucleophilic addition of hydroxide ions to crystal violet. The nanoreactor structure was characterized by rheology and small-angle X-ray scattering (SAXS), while the reaction kinetics were monitored *in situ* by UV-Vis spectroscopy during ammonia gas permeation.
The results demonstrate that the reaction proceeds significantly faster in RWMs than in bulk aqueous solution [3], highlighting the role of confinement in enhancing the reaction rate. Rheological and SAXS analyses showed that the reaction does not compromise the structural integrity of the RWMs, although systems with narrower aqueous channels (ACs) exhibit greater changes in their viscoelastic response (Figure 1A). Kinetic measurements revealed that increasing the alkane chain length progressively decreases the reaction rate, following the order C8 > C9 > C10 > C11 (Figure 1B). This behavior reflects the combined effects of ammonia diffusion through the continuous alkane phase and the degree of confinement imposed by the nanoreactors. Overall, these findings demonstrate that the structure of RWMs [4] can be tailored to modulate nucleophilic reactions under confined conditions, providing new insights into the rational design of self-assembled nanoreactors for confined chemical processes.

**Keywords:**
Anisotropic nanoreactors, Reverse wormlike micelles, Soft confinement, Nucleophilic reaction

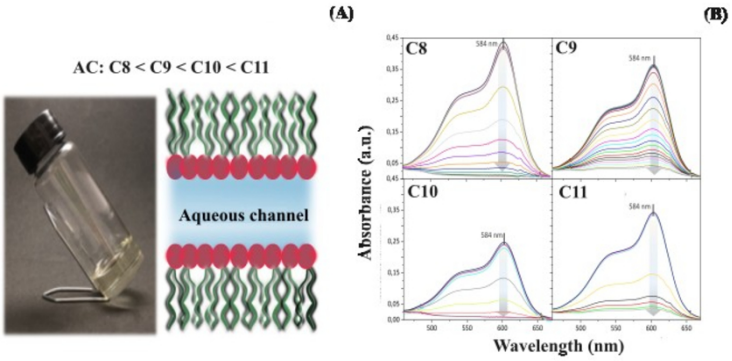


*Figure 1. (A) Schematic representation of the aqueous channel (AC) in reverse wormlike micelles (RWLMs), illustrating the order of the aqueous channel diameter (C8 < C9 < C10 < C11). (B) Crystal violet reaction kinetics monitored by UV–Vis spectroscopy for the four alkanes over 290 min.*

**References:**

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