Nanofiltration Membranes with Dendritic Amphiphilic Aromatic Polyamide Active Layers

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The nanofiltration (NF) membrane technique is emerging as an efficient and economic drinking water treatment process, because of its ability to remove colloidal, organic, and ionic contaminants from water. In this work, dendritic amphiphilic aromatic polyamides were synthesized and used to fabricate active layers of NF membranes by direct percolation onto polyethersulfone (PES) support film. Applying different dendrimer generations for fabrication allows us to systematically investigate the influence of dendrimer size on the evolution of NF membrane structure as well as membrane performance. Characterization techniques used include UV-Vis spectroscopy, FE-SEM, AFM and Rutherford backscattering spectrometry (RBS). The resulting membranes exhibit significant enhanced water permeability while maintaining high rejection of water contaminants compared to commercial NF membranes.

Development of DNA Catalysts for Protein Side Chain Modification

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Deoxyribozymes are catalytic DNA molecules that are identified by in vitro selection. Our laboratory previously used in vitro selection to identify deoxyribozymes able to catalyze reactivity of a tyrosine side chain that is covalently embedded within a DNA substrate. The highly preorganized architecture of the deoxyribozyme-substrate complex (left side of figure) presents the amino acid side chain nucleophile in close proximity to the 5′-triphosphate-RNA electrophile, leading to formation of a tyrosine-RNA nucleopeptide linkage. Building upon this initial result, here we sought to circumvent the requirement for a highly preorganized structure by presenting the side chain of tyrosine in a less preorganized fashion during in vitro selection. From multiple in vitro selection pathways, we identified several deoxyribozymes that catalyzes tyrosine side chain reactivity in a non-preorganized fashion (right side of figure). For example, the 15MZ36 deoxyribozyme that catalyzes ligation between the tyrosine side chain of a non-tethered Cys-Tyr-Ala tripeptide substrate and the 5′-triphosphate of RNA, with k_{obs} = 0.31 h^{-1} ($t_{1/2}$ = 2.2 h) and >50% yield. This finding and related results offer encouragement that DNA catalysts can be developed for practical use to modify specific side chains of peptide and protein substrates.