**Photo-induced Recovery, Optical Detection, and Separation of Noxious SeO32− Using Mesoporous Nanotube Hybrid Membrane**

A macroscopic-scale disc-like membrane capable of photo-induced recovery, optical detection, and separation of ultra-trace levels of SeO32− was fabricated using a mesoporous TiO2–SiO2 nanotube (TSN)–porous anodic alumina (PAA) hybrid. The synergistic pressure-assisted filling and condensed formation of TSN inside the entire PAA (200 nm channel neck size and 60 μm longitudinal length) were evident. This approach enabled fabrication of optical, photo-induced macroscopic membrane sensor (MS) by direct embedding of the organic colorant onto the long and mesoporous TSN/PAA channels. The TSN-MS structure of uniformly aligned, long, interconnected, tubular and nano-sized channel-like pores integrated the control patterns of photo-induced SeO32− recovery/extraction through surface chelation. As a result, a stable and recyclable TSN-MS against long-term exposure to UV light (for several days) is produced. MS functionality in terms of optical detection and selective separation (i.e., rejection and permeation) of toxic SeO32− among a group of interfered ions was assessed using a simple desktop filtration technique. The developed TSN-MS holds promise for use in advanced indoor and outdoor recovery, detection, and separation of SeO32− from aquatic sources in a one-step process. Our findings expand efforts for environmental approach for production of SeO32−-free water, photo-hazardous SeO32− collection and management, and volume reduction of solution or solid wastes after multi-cyclic remediation.