RESEARCH INSTITUTE FOR SUSTAINABLE URBAN DEVELOPMENT (RISUD)

News Article for RISUD Emerging Frontier Area (EFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Yi JIANG	CEE
2.	**Name of EFA:**	Nanotechnology, Environment, and Urbanization Nexus	
3.	**Project Title:**	New paradigm of water separation membranes	

4. **First Year Progress/Achievement (***in layman's language, no more than two A4 pages***)**

By 2050, 6.5 billion people are projected to be living in urban areas, which then will account for more than two-thirds of the world's population. Amidst the urbanization, there has been a boom in mega-cities. Water infrastructures, such as water and wastewater treatment facilities, are critical to the sustainable development of cities.

Membrane separation is regarded as the most important unit process in the next-generation water and wastewater treatment facilities. A membrane acts as a selective barrier, which allows water to pass through but stops other constituents, such as salts (reverse osmosis), organic matters/bacteria (ultrafiltration), particles (microfiltration), and so forth. In spite of its technological advantages, the current hurdle for the large scale application of membrane separation is its high cost and inherent technical flaws, which can be solved by developing a new paradigm of low-cost, high-performance, tailorable water separation membranes.

This EFA project directly responds to these technological development needs, and aims at developing a new paradigm of membranes that have novel composite structures, by incorporating new functional materials (i.e., carbon nanomaterials and biopolymers) using advanced manufacturing methods (e.g., 3D printing). In our first year of project implementation, research progress have been made for all three objectives. All necessary experimental devices have been established for the synthesis and evaluation of nanocomposite membranes, which include, a 3D printer, an electrospray set-up, a spray set-up, and two sets of membrane filtration instrument (Figure 1). One fulltime research associate and two PhD students have been assigned to work on the project-related research tasks. Multidisciplinary collaboration has also been established among PI and Co-PIs/Co-Is from PolyU/HKU. Significant preliminary results have been obtained, and a number of papers are under preparation.

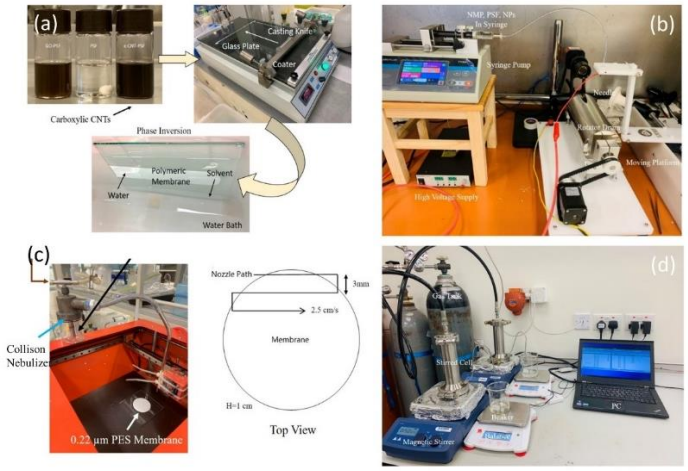

Figure 1. A suite of experimental set-ups have been established to achieve project success: (1) a membrane casting instrument; (2) an electrospray set-up; (3) a spray set-up; (4) membrane filtration sets.

Specifically, with regard to project outcomes to date, we firstly synthesized polysulfone ultrafiltration membranes impregnated with different amount of graphene oxide (GO)/carboxylic carbon nanotubes (c-CNT) (Figure 2). We then systematically analysed their structure using both microscopic and spectroscopic techniques, and evaluated membrane performance with a spectrum of solute solutions (dye, polymer, and protein). This was to establish the underlying structure-performance relationships, which provided knowledge for design of novel nanocomposite membranes prepared by phase inversion, an industrially relevant process. Furthermore, electrospray and spray (3D printing) set-ups have been built to develop aerosol-assisted synthesis approaches. We first developed a new synthesis approach via electrospray to achieve stable, controlled, uniform and high coverage of c-CNT on membrane surface, which creates a new form of membrane surface structure and enhances long-term antimicrobial activity of membranes. Lastly, secondary effluents from both Tai Po and Sha Tau Kok wastewater treatment plants were collected. At current stage, 9 commercial ultrafiltration and nanofiltration membranes are being evaluated in terms of their performance to treat these secondary effluents for wastewater reuse purpose, which also serve as a benchmark for our as-synthesized nanocomposite membranes.

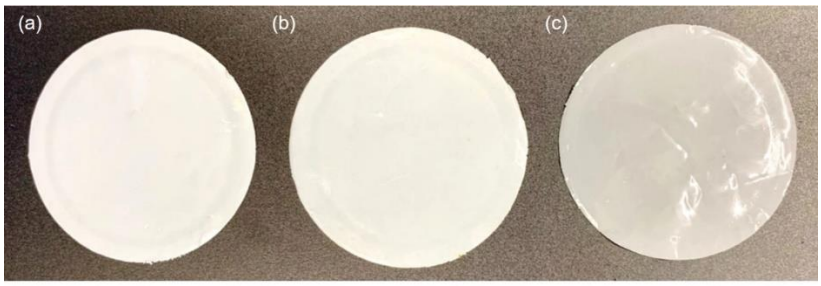

Figure 2. Photos of a (a) PSF, (b) GO-impregnated, and (c) c-CNT-impregnated membrane coupon.

Continued success of this project in the coming 2-year project duration will ultimately produce technology and knowledge that will help the building/upgrading of drinking water and wastewater treatment facilities in Hong Kong (and the rest of the world) in the near future.