

Significance

Water is essential for living organisms present on the earth. Human requires water for agriculture, drinking, washing and other living purposes. Freshwater is significantly affected by hazardous human activities which results in water pollution. Out of all the water on earth, only 3% (freshwater) is considered suitable for the consumption of humans, the rest of water is in oceans with a large number of dissolved salts. Therefore water pollution and scarcity are becoming global problems.

Materials and Methodology

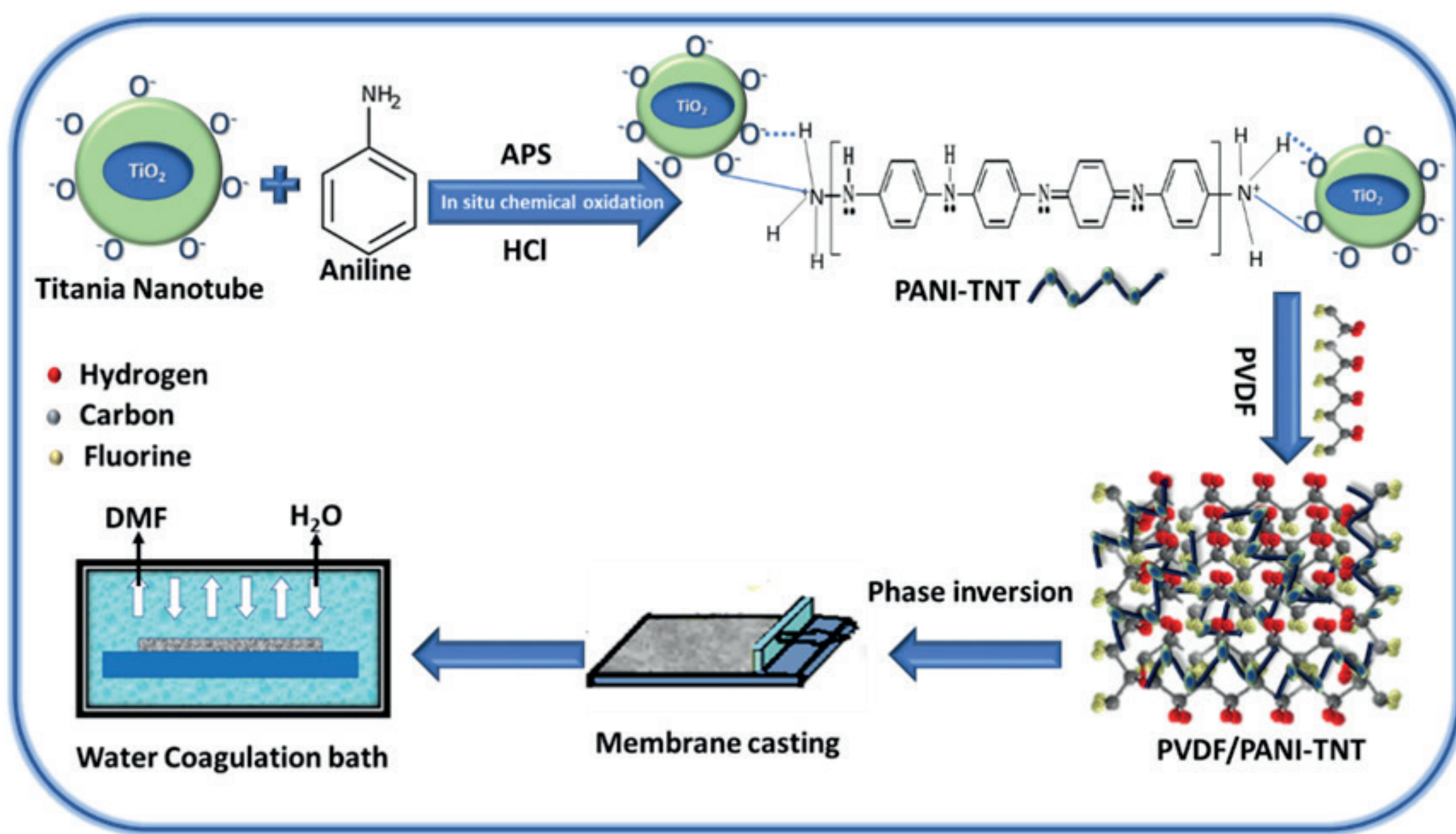


Fig. 2. Schematic illustrations of the manufacturing process of nanocomposite membrane.

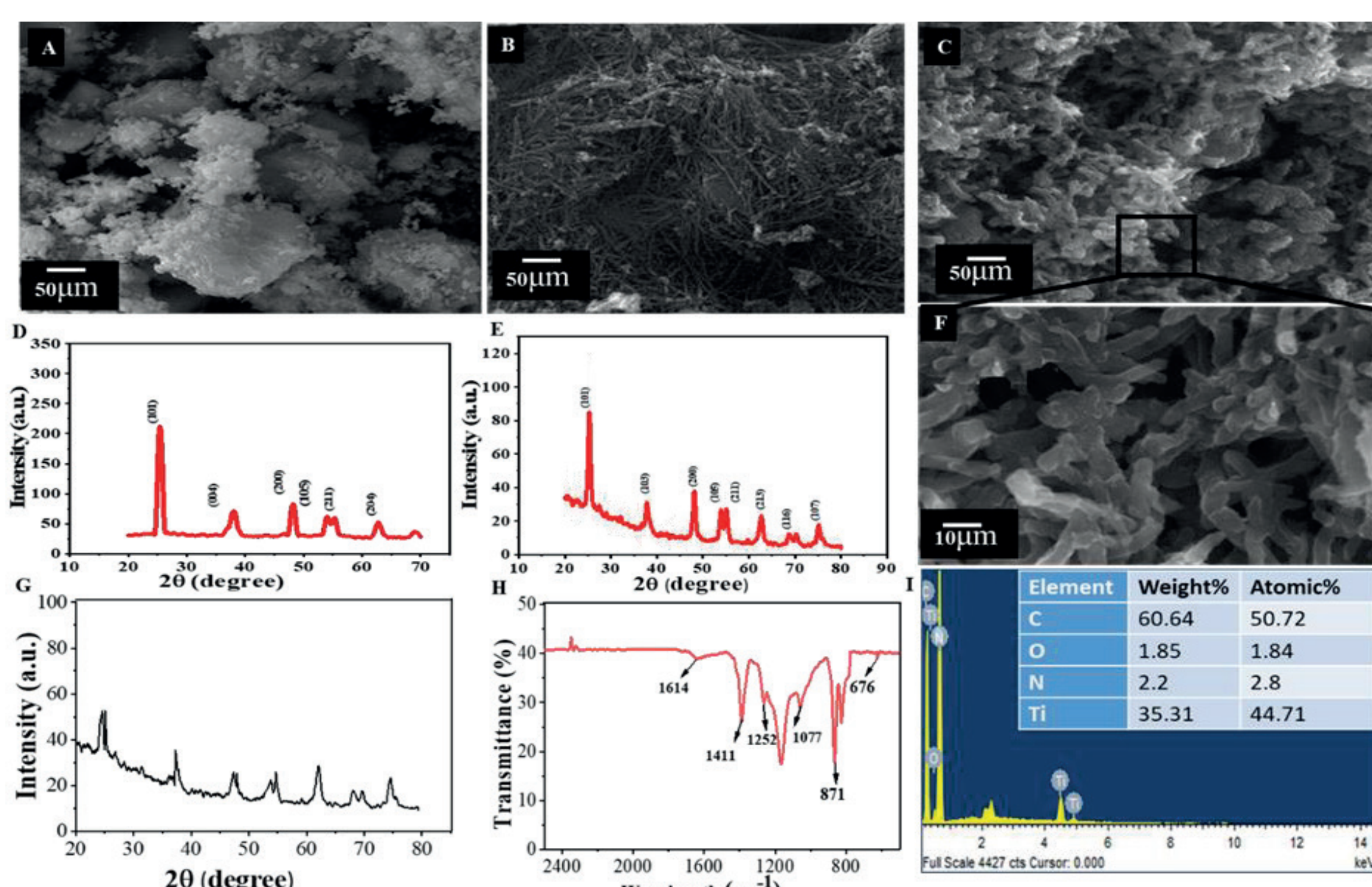


Fig. 3. SEM image of (A) titania nanoparticles, (B) nanotubes (C) polyaniline-titania nanotube composites. XRD analysis of (D) titania nanoparticles (E) titania nanotubes. (F) Close up (G) XRD. (H) FTIR (I) EDX analysis of polyaniline-titania nanotube composite.

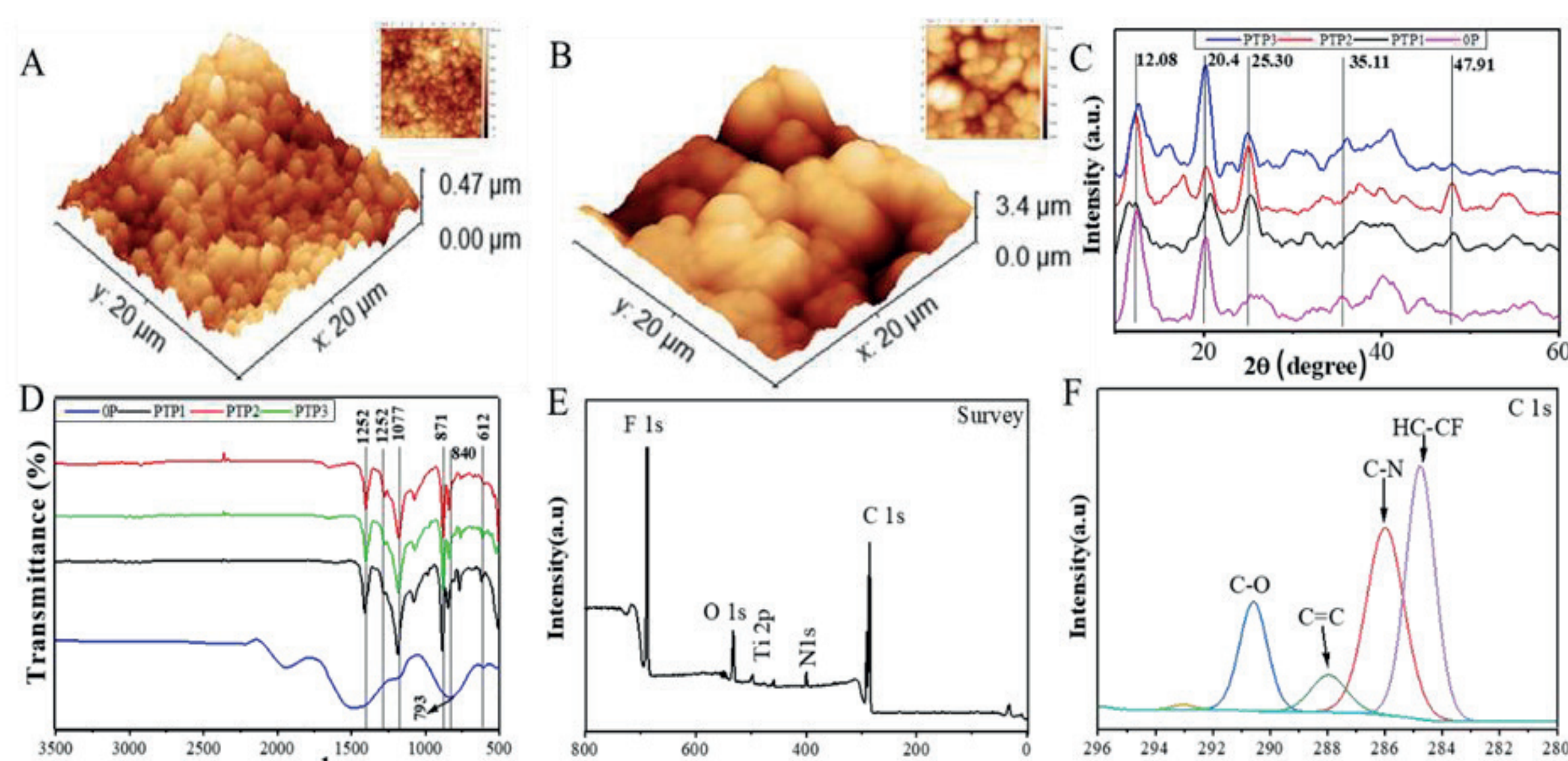


Fig. 4. AFM images of (A) pure PVDF membrane (B) AFM images (C) XRD graphs (D) FTIR (E) XPS analysis. (F) C1s spectrum of PVDF/PANI-TNT composite membrane.

Mechanism

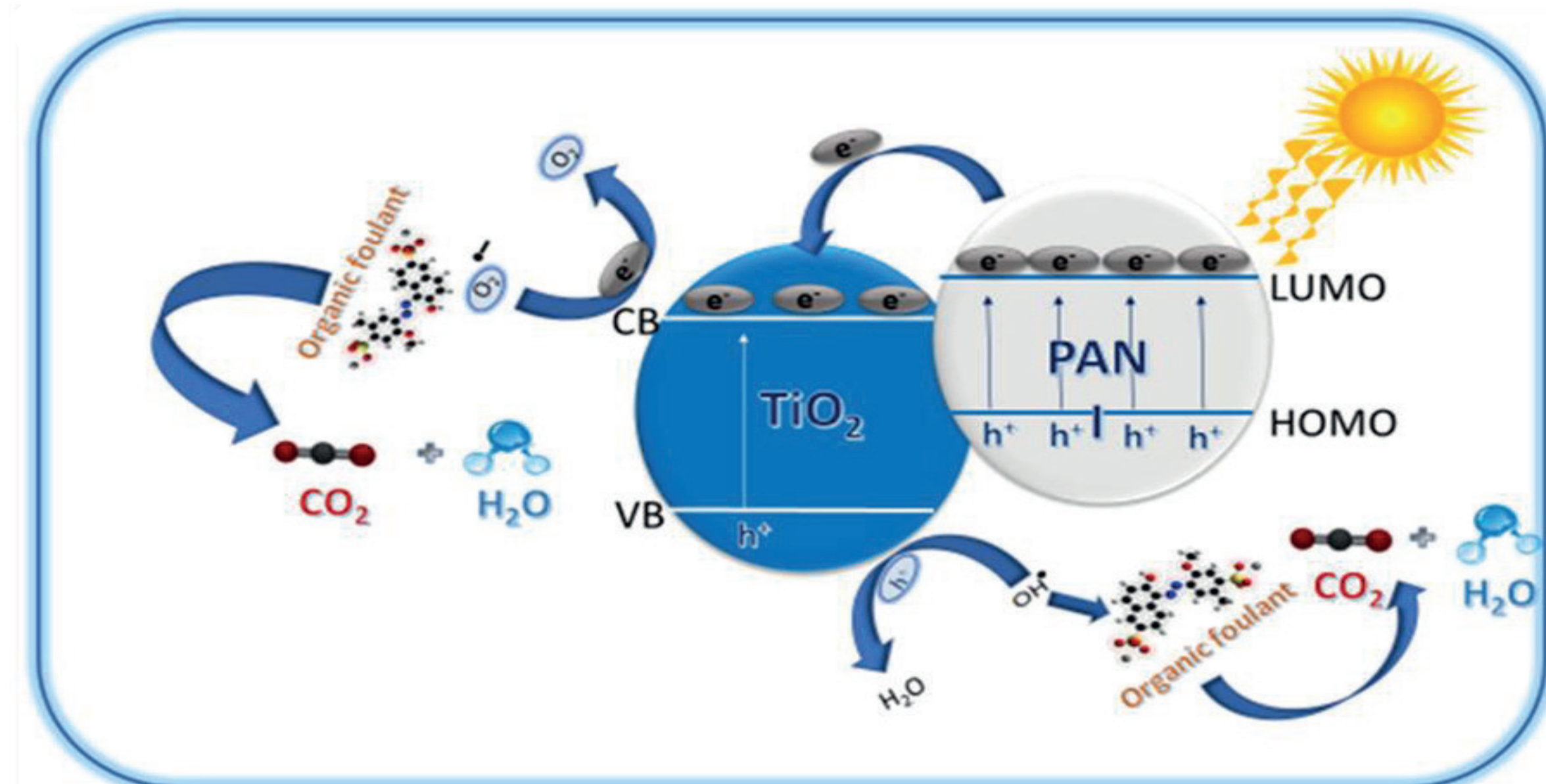


Fig. 5. An illustration of photocatalytic degradation mechanism of PVDF-PANI-TNT nanocomposite membrane.

Novelty

The novel developed membranes exhibit photocatalytic activities due to the presence of titania nanotubes, and adsorption of methyl orange (MO) reduces significantly with the UV light irradiations.

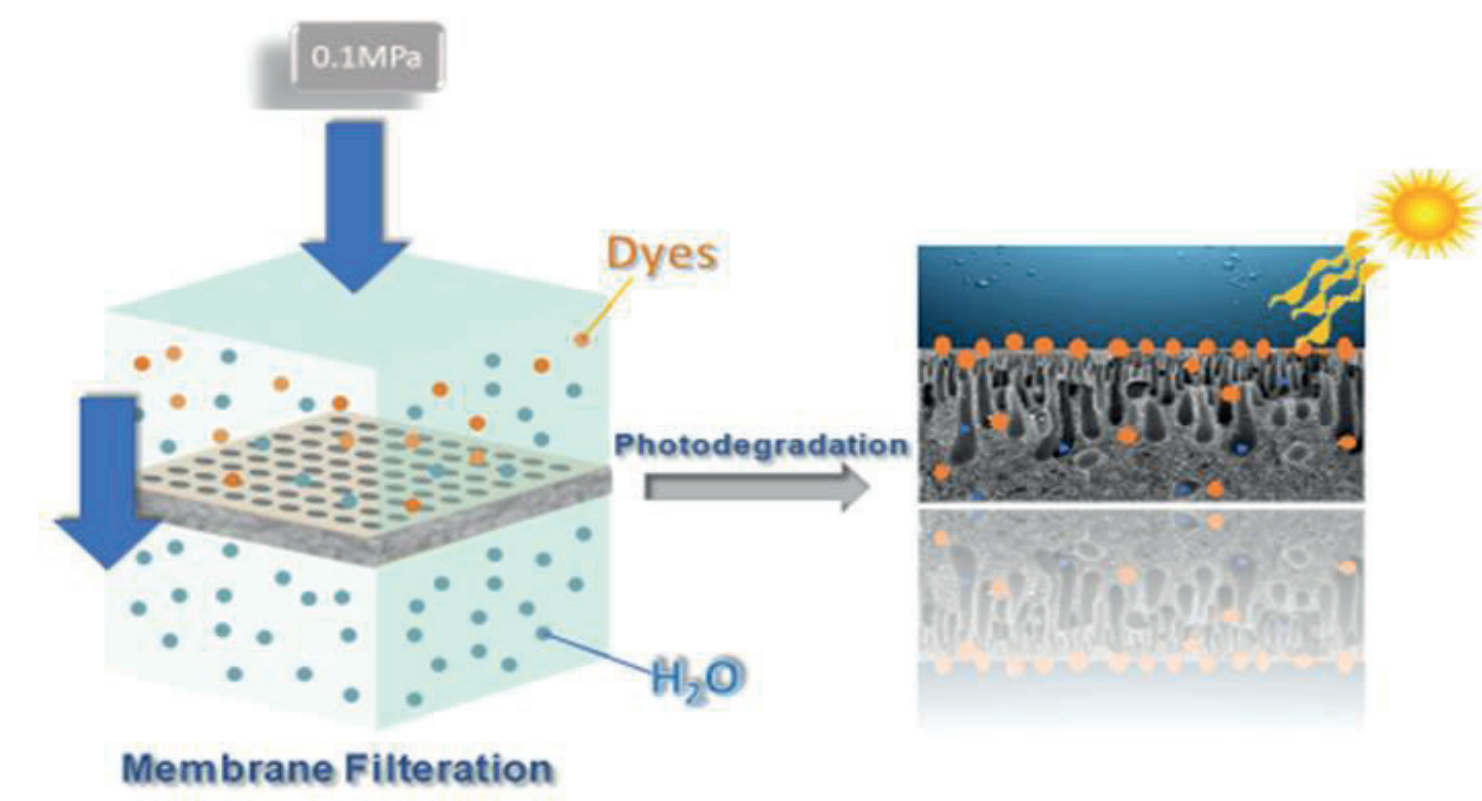


Fig. 1. Photodegradation of dyes via nanocomposite membranes.

Results

TNTs and PANI composite within the synthesised membrane improve the removal efficiency of dye molecules (AR is 88% and MO is 90%). Water purification performance such as BSA rejection, flux recovery ratio and long-term stability of nanocomposite membrane also improved with increment in concentration of fillers.

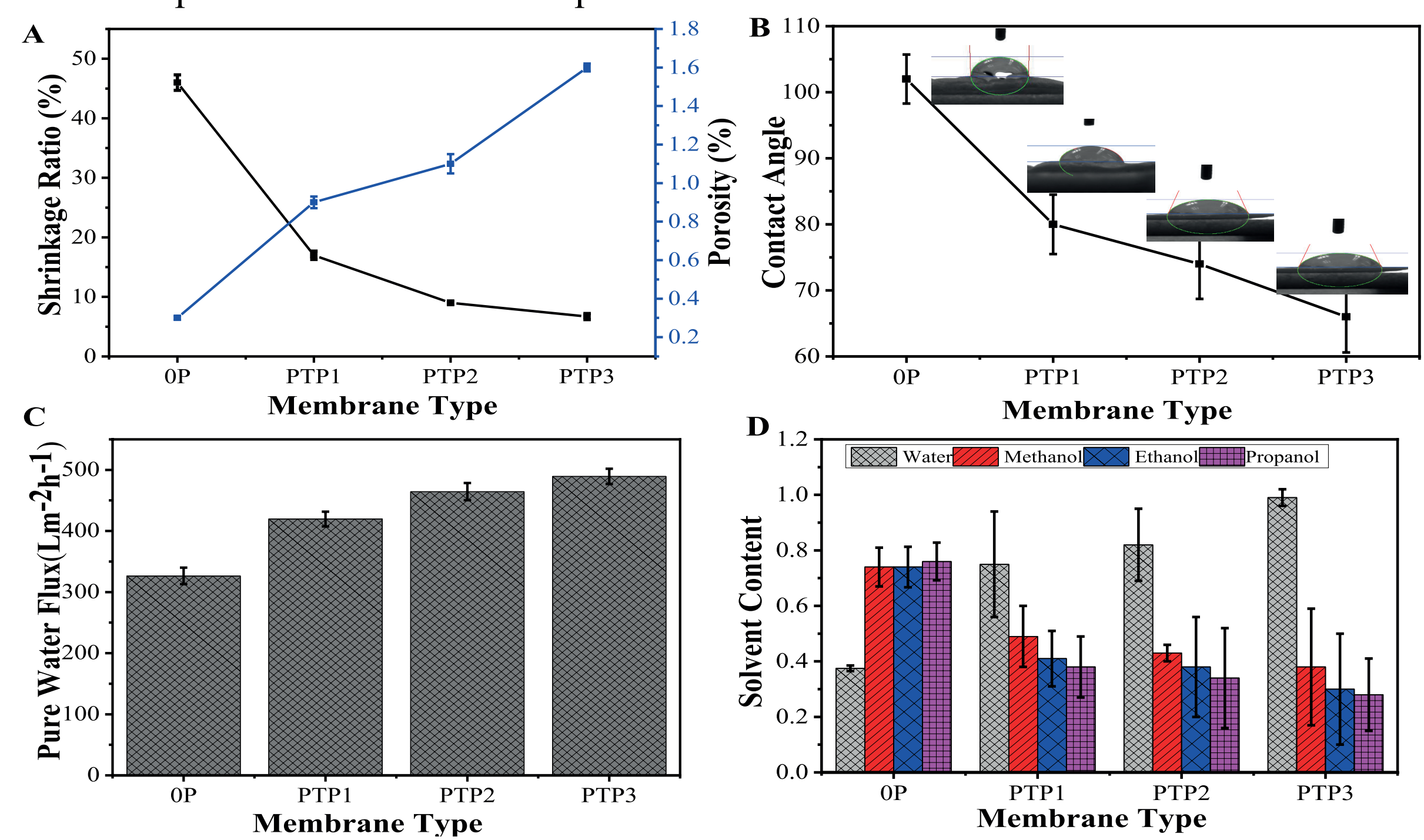


Fig. 6. (A) Shrinkage ratio and porosity (B) Contact angle (C) Pure water flux (D) Solvent contents of PVDF-PANI-TNT composite membranes in different mediums i.e. methanol, ethanol, propanol and water.

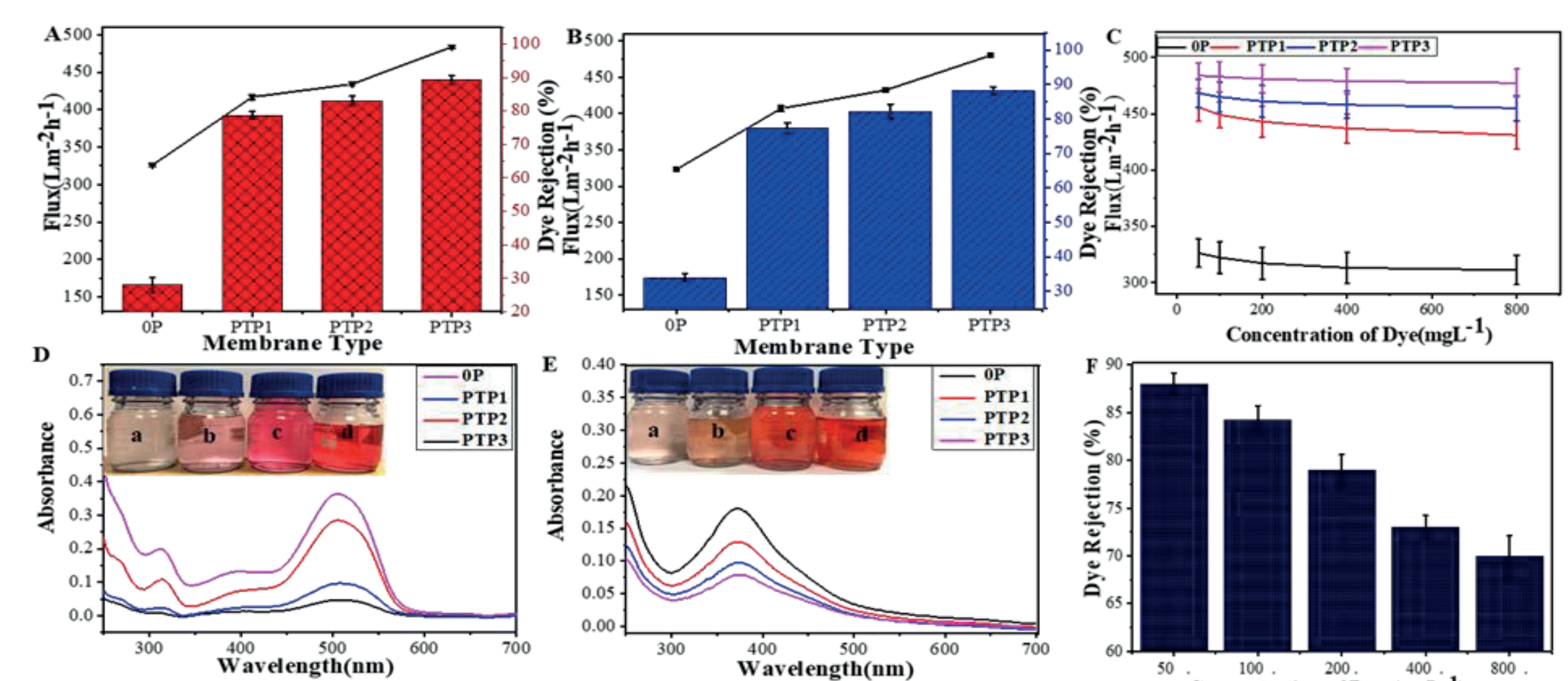


Fig. 7. (A) Dye rejection (Allura Red) and flux (B) Dye rejection (methyl orange) and flux (C) Dye concentration effect on dye flux. (D) UV-vis Spectroscopy of Allura Red. (E) UV-vis spectroscopy of methyl orange. (F) Dye concentration effect on dye rejection.

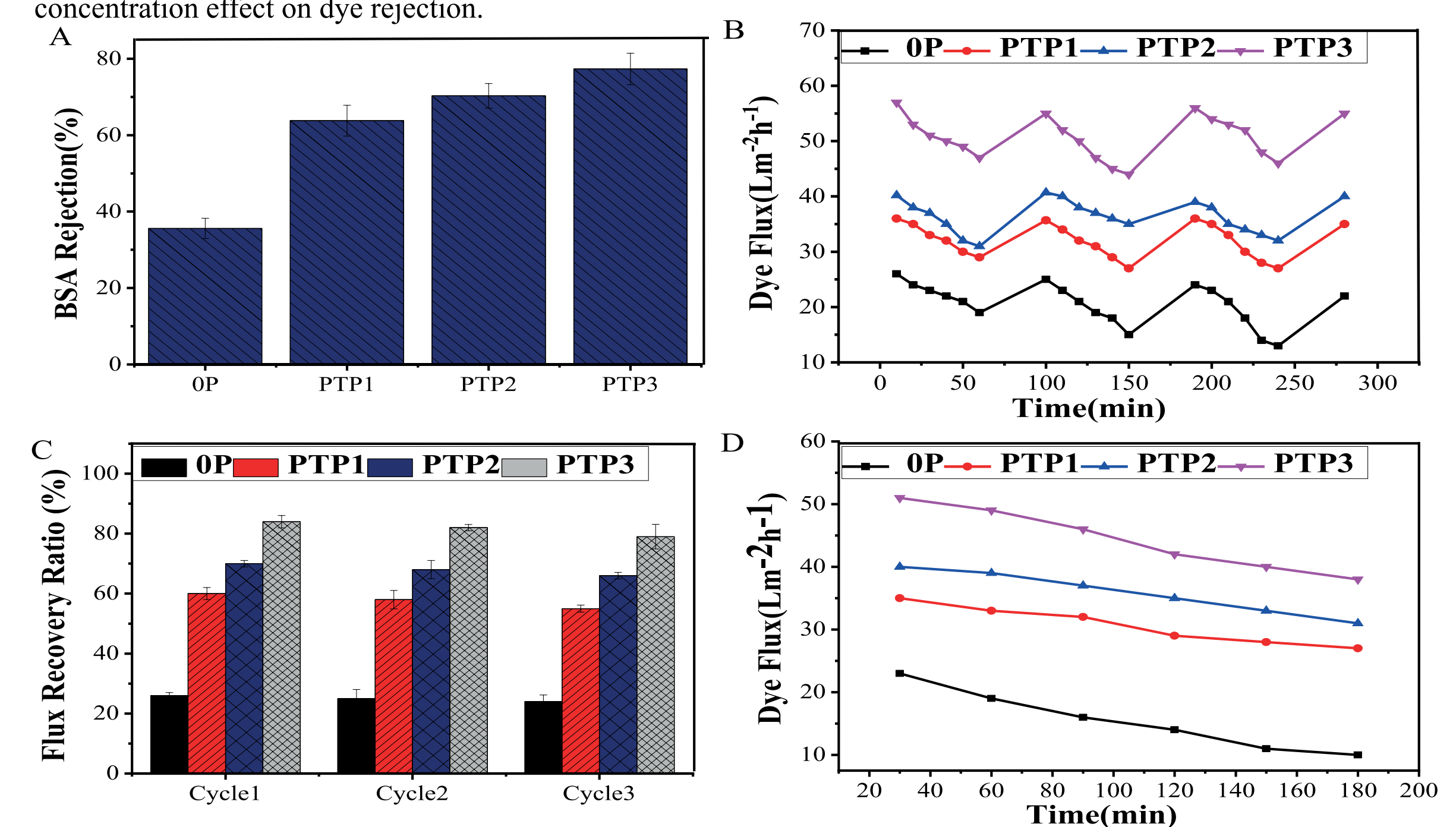


Fig. 8. BSA rejections (A), Capabilities of membrane recycling (B), FRR (C), and Dyes flux (D) of membranes. The results show that embedded PANI-TNT within nanocomposite was photo-catalytically active and degrade the dye molecules from the surface of the nano-composite membrane.

References

- C. Ji, et al., "Recent advances in high-performance TFC membranes: a review of the functional interlayers." *Desalination* 500 (2021) 114869.
- N. Hifza, et al., "Photodegradation of textile pollutants by nanocomposite membranes of PVDF integrated with PANI-TNTs." *Chemical Engineering Journal* 419 (2021): 129542.

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