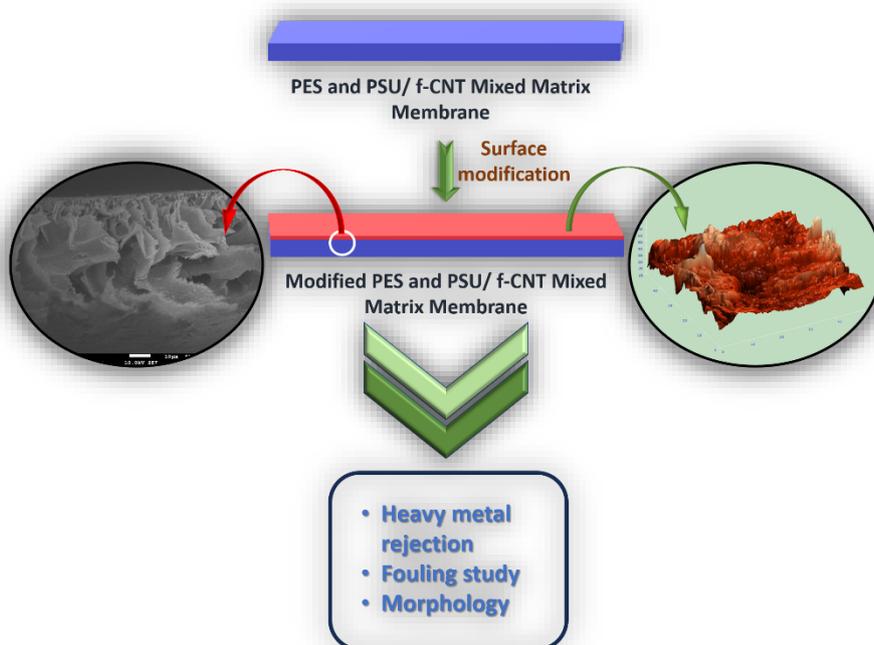


Chapter 2

Scope of research



2.1 Scope of work

Membrane technology has gained widespread popularity across various industries, including water and wastewater treatment, food processing, the chemical industry, biotechnology, the medical and pharmaceutical sectors, water desalination, blood purification, and energy applications using fuel cells. Its use has increased due to its many benefits, such as improved energy efficiency, cost-effectiveness, scalability, and easy operation. Notably, the chemical industry is experiencing high growth in the adoption of membrane materials because of their exceptional stability. Membrane technology is a physical process that involves filtering wastewater to remove contaminants in a range of sizes (micro to nano). In wastewater treatment, the membrane technology used to remove solids is usually ultrafiltration or microfiltration. Membrane technology has a significant potential for rejection of heavy metals from wastewater. It can be used in pressure-driven membranes, liquid membranes, adsorption, adsorptive membranes, and membrane filtration for heavy metal removal.

The objective of this research was to examine the impact of surface modification on a polysulphone-based mixed matrix membrane incorporated with diverse functionalized carbon nanotubes. Different functionalities were introduced onto the membrane surface through click reactions and simple reactions with trimesoyl chloride, cyanuric chloride, and polyethylenimine, utilizing the available functional groups on the membrane surface. The performance of the modified membrane, such as its ability to reject heavy metals and prevent fouling, was then analyzed.

“The goal of this research is to enhance heavy metal rejection by modifying the mixed matrix membrane without affecting its overall structure and also improving its anti-fouling properties.”

2.2 Objective of the study

Functionalized carbon nanotubes incorporating polysulfone and polyether sulphone mixed matrix membranes demonstrated higher heavy metal rejection and improved antifouling properties. This was because of the adsorption and complexation capabilities of the heavy metal ions on the membrane surface. As the functionality of the membrane surface increases, heavy metal rejection also improves.

This research is focused on improving the properties of polysulfone and polyether sulphone mixed matrix membranes by modifying their surface. The aim is to introduce new functional groups or increase the functionality of the membrane surface, resulting in improved characteristics.

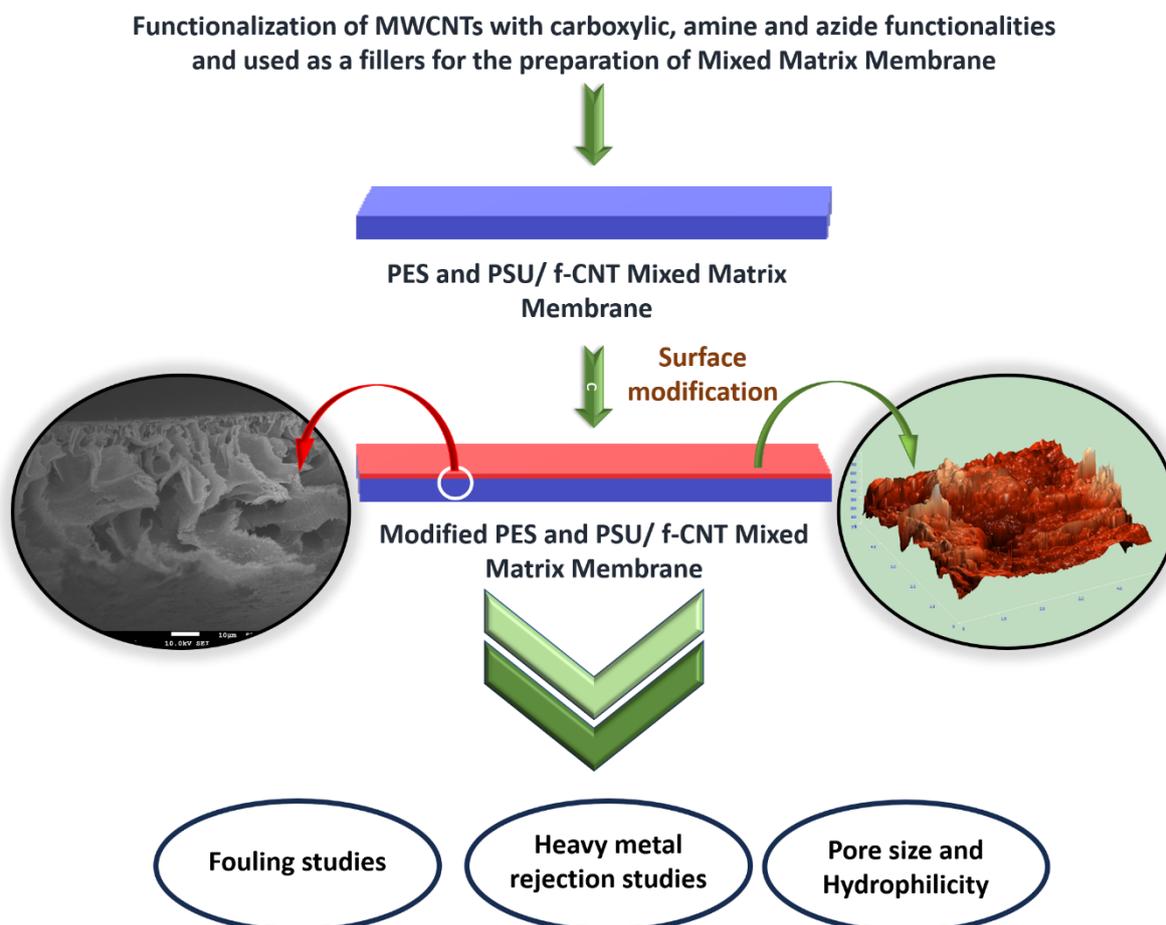


Figure 2.1. Surface modification of membranes and their characterization.

The Objectives of this study are:

1. To functionalize multiwalled carbon nanotubes with carboxyl, amine, and azide functionalities and then characterize them. The functionalized multiwalled carbon nanotubes (f-MWCNTs) were used as fillers to prepare mixed matrix membranes.
2. The preparation of polysulphone and polyether sulphone mixed matrix membranes incorporating carboxy-, amine-, and azide-functionalized multiwalled carbon nanotubes. The membranes were then subjected to surface modification by means of

click reaction and simple reactions with trimesoyl chloride, cyanuric chloride, and polyethylenimine, depending on the available functional groups on the membrane surface.

3. To modify the surface of a polysulphone/azide-MWCNT mixed matrix membrane was modified via a click reaction, resulting in the conversion of azide groups into triazole rings. The modified membrane was then analyzed by XPS to confirm the successful conversion and for its heavy metal rejection and antifouling properties, as well as morphology characterization.
4. To modify the polysulphones/ amine-MWCNTs mixed matrix membrane having an amine functional group on the membrane surface using the trimesoyl chloride and cyanuric chloride, which creates the amide linkages on the membrane surface. This modified membrane would characterize for heavy metal rejection study and antifouling property, also morphology of these modified membrane would be studied using SEM and AFM.
5. Modify the polysulphone/oxidized-MWCNT mixed matrix membrane with a carboxylic functional group on the membrane surface, which reacts with polyethylenimine (PEI). This treatment with PEI creates a positive charge on the membrane surface owing to the presence of amine functional groups. The effect of the positive charge on the membrane surface on heavy metals would be studied.