



Study on Novel Oil-Water Separation Membrane

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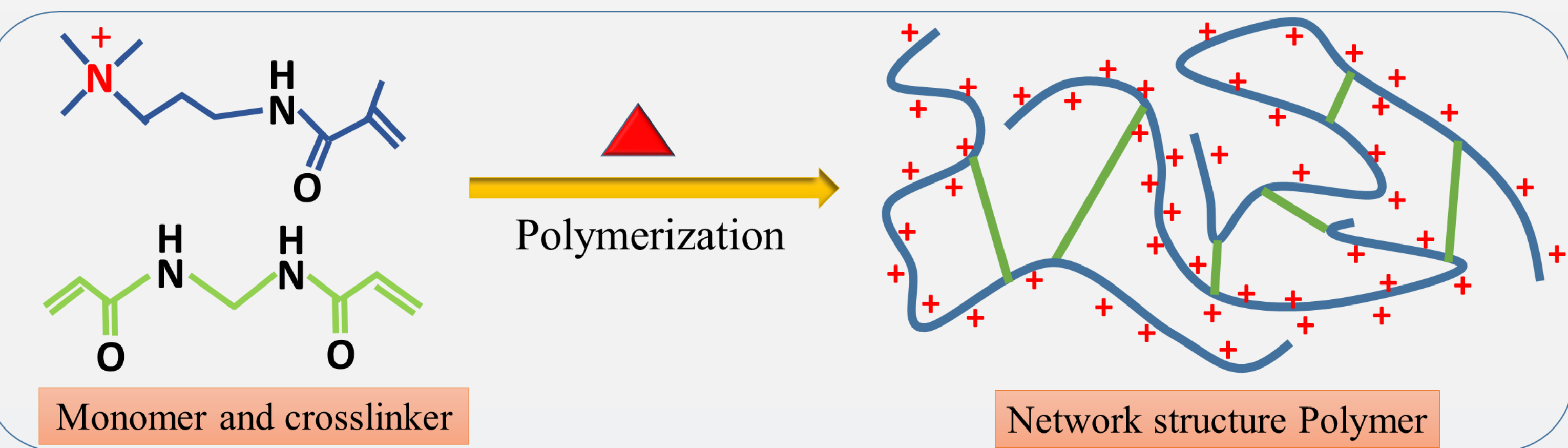
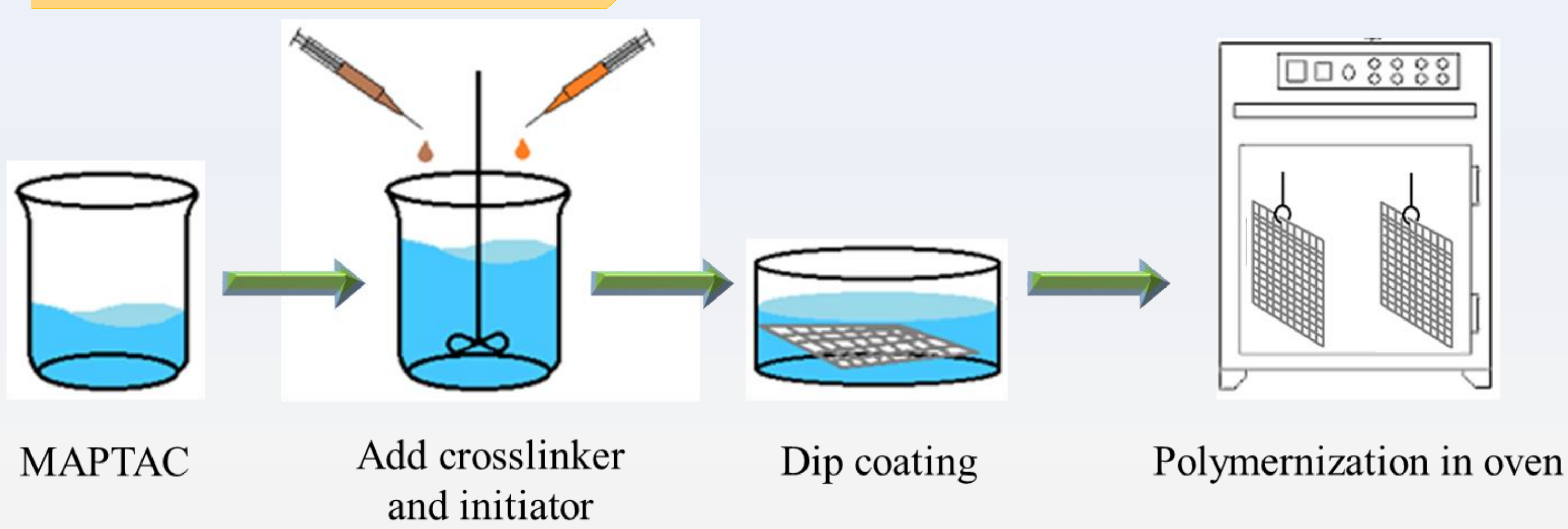


Abstract

The novel oil-water separation membrane with hydrophilicity and oleophobicity can be used to treat industrial oily wastewater or spilled oil by accidents. These membranes also had the advantage of none secondary pollution^[1]. Hence, novel oil-water separation technologies have received broad attentions in recent years. However, oily wastewater often contained many kinds of substances, including microorganisms^[2]. There were little reports about oil-water separation membrane with antibacterial property and high oil-water separation efficiency.

In this study, two quaternary ammonium salt monomers, ([2-(Methacryloyloxy) ethyl] trimethylammonium chloride, MAETAC and [3-(Methacryloylamino)propyl] trimethyl- ammonium chloride, MAPTAC) with hydrophilic and bacteriostatic properties were used to study the oil-water separation efficiency. The results showed that PMAETAC was not suitable for oil-water separation membrane material due to its high hydrolysis reaction^[3]. However, PMAPTAC suited for oil-water separation membrane material, owing to low hydrolysis reaction and high conversion of 99% at polymerization time of 2.5 hours. When the number of oil-water separation membrane mesh is 100, the oil-water separation efficiency and separation flux are 48% and 30298 L h⁻¹m⁻², respectively. The oil-water separation efficiency can be increased to 99% on the condition of the mesh number increasing to 300. The oil-water separation membrane prepared at best fabricated parameters has separation efficiency above 95% under different acidic, alkali, salt, temperature and emulsion conditions.

Experimental



Results And Discussion

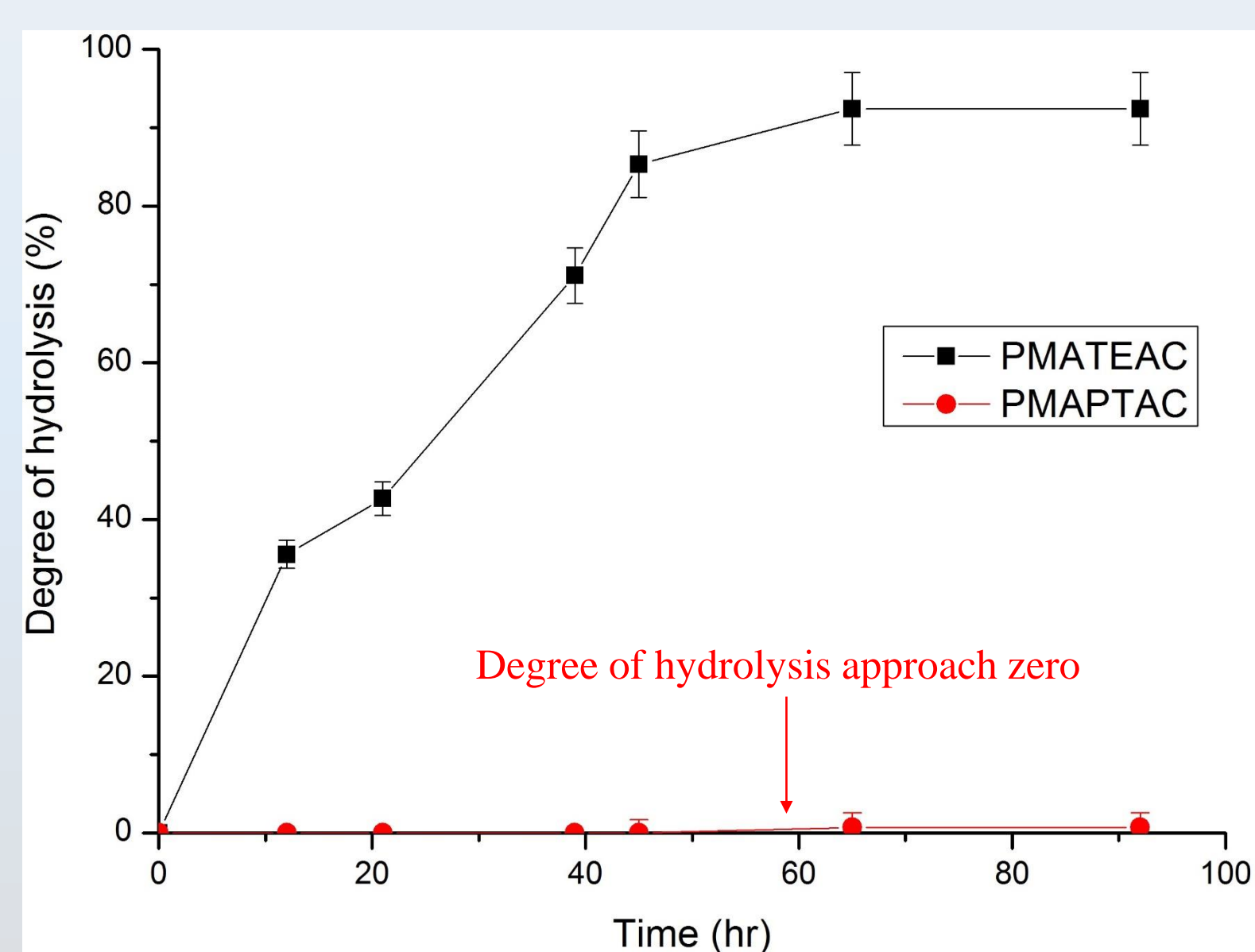


Fig.1 The degree of hydrolysis of PMATEAC and PMAPTAC.

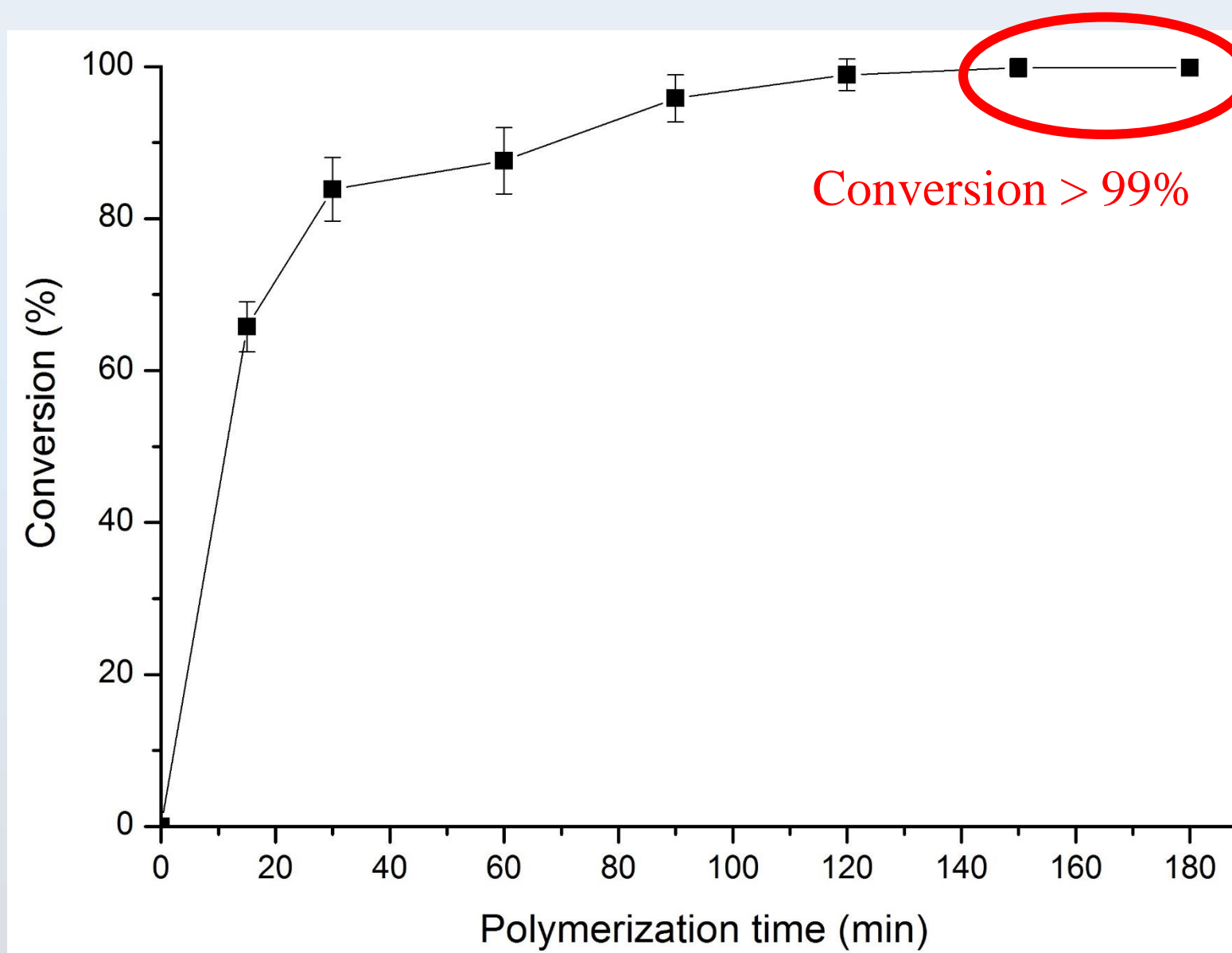


Fig.2 Polymerization time-conversion curves for the polymerization of MAPTAC.

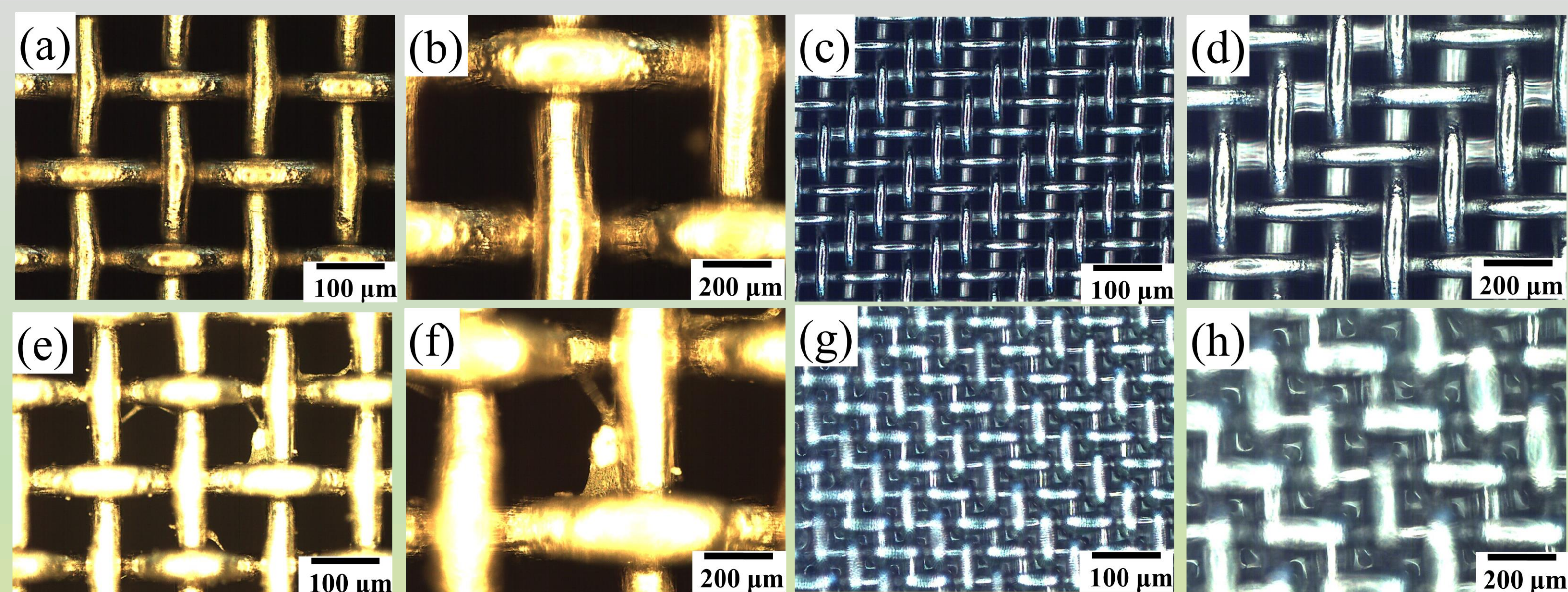


Fig.3 SEM images of the stainless steel mesh and PMAPTAC-coated mesh prepared from a stainless steel mesh. Large-area view of the uncoated stainless steel (a)100 mesh.(c)300 mesh. Enlarged view of the uncoated stainless steel (b) 100 mesh. (d) 300 mesh. Large-area view of the PMAPTAC-coated mesh (e)100 mesh.(g)300 mesh. Enlarged view of the PMAPTAC-coated mesh (f) 100 mesh. (h) 300 mesh.

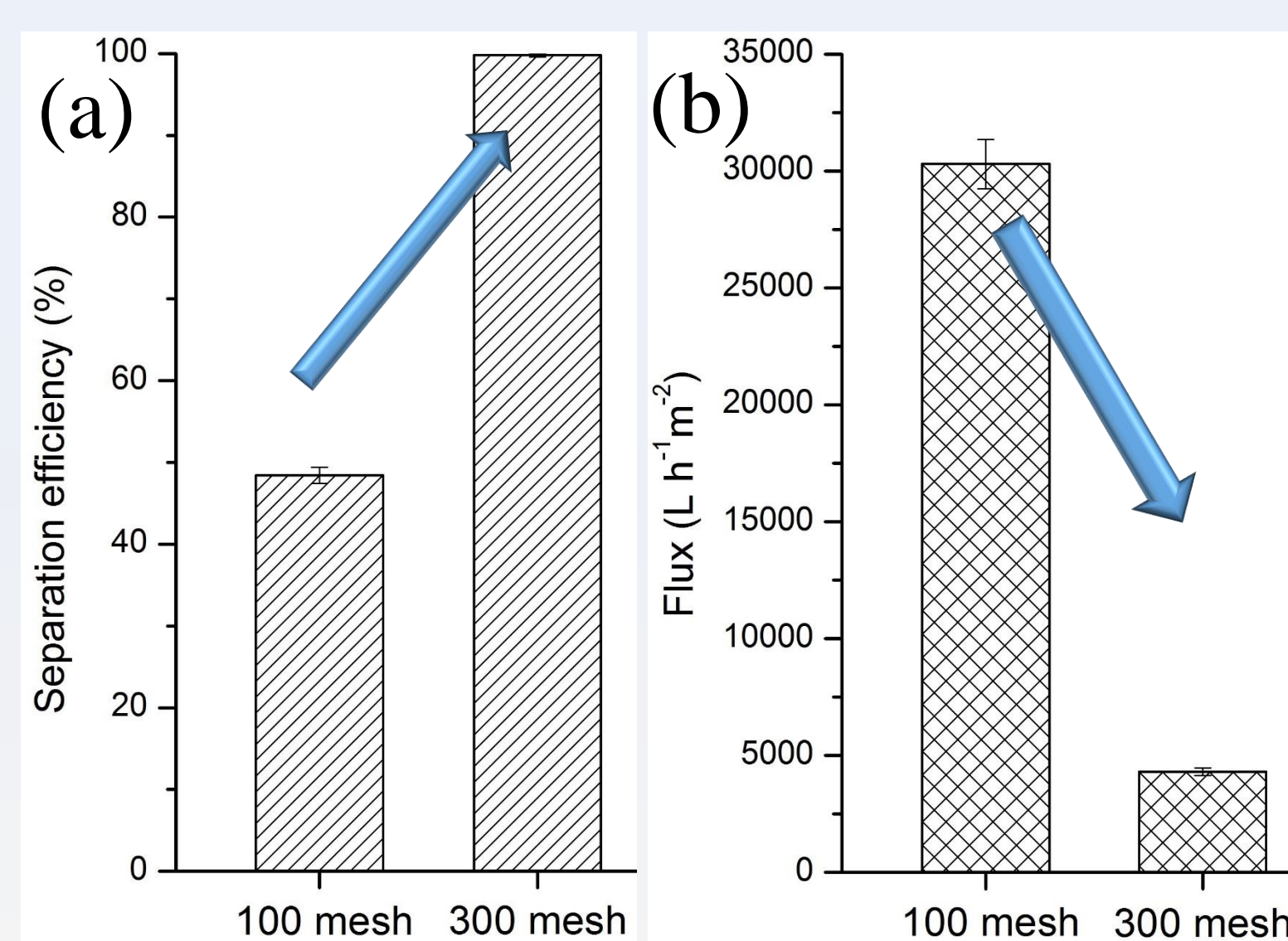


Fig.4 Effects of oil-water mixture (concentration of vegetable oil : 30 v/v%, temperature:30°C) at different mesh number on the (a) separation efficiency and (b)flux.

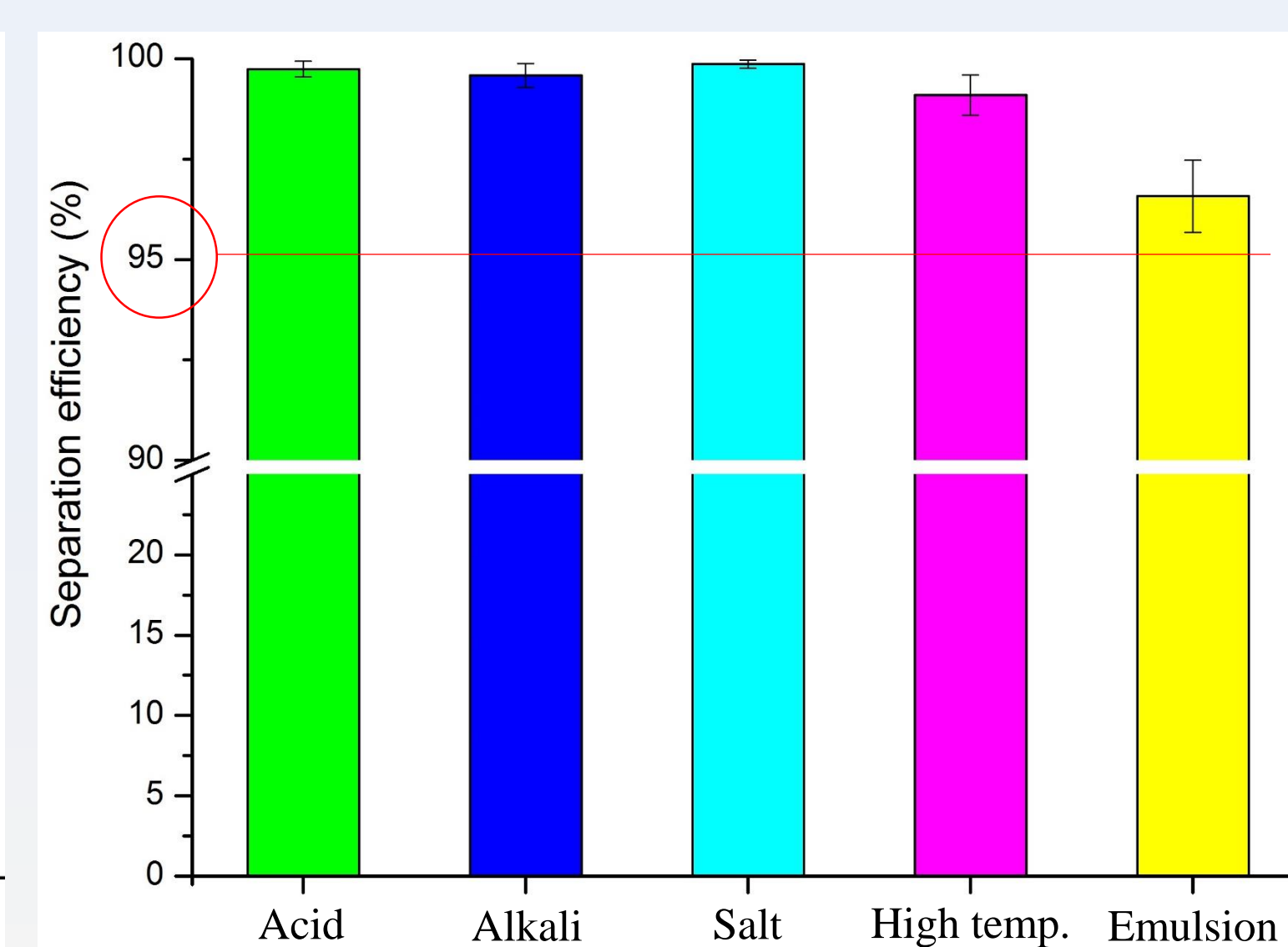


Fig.5 separation efficiency of oil-water separation membrane with best fabricated parameters under different acidic, alkali, salt, temperature and emulsion conditions.

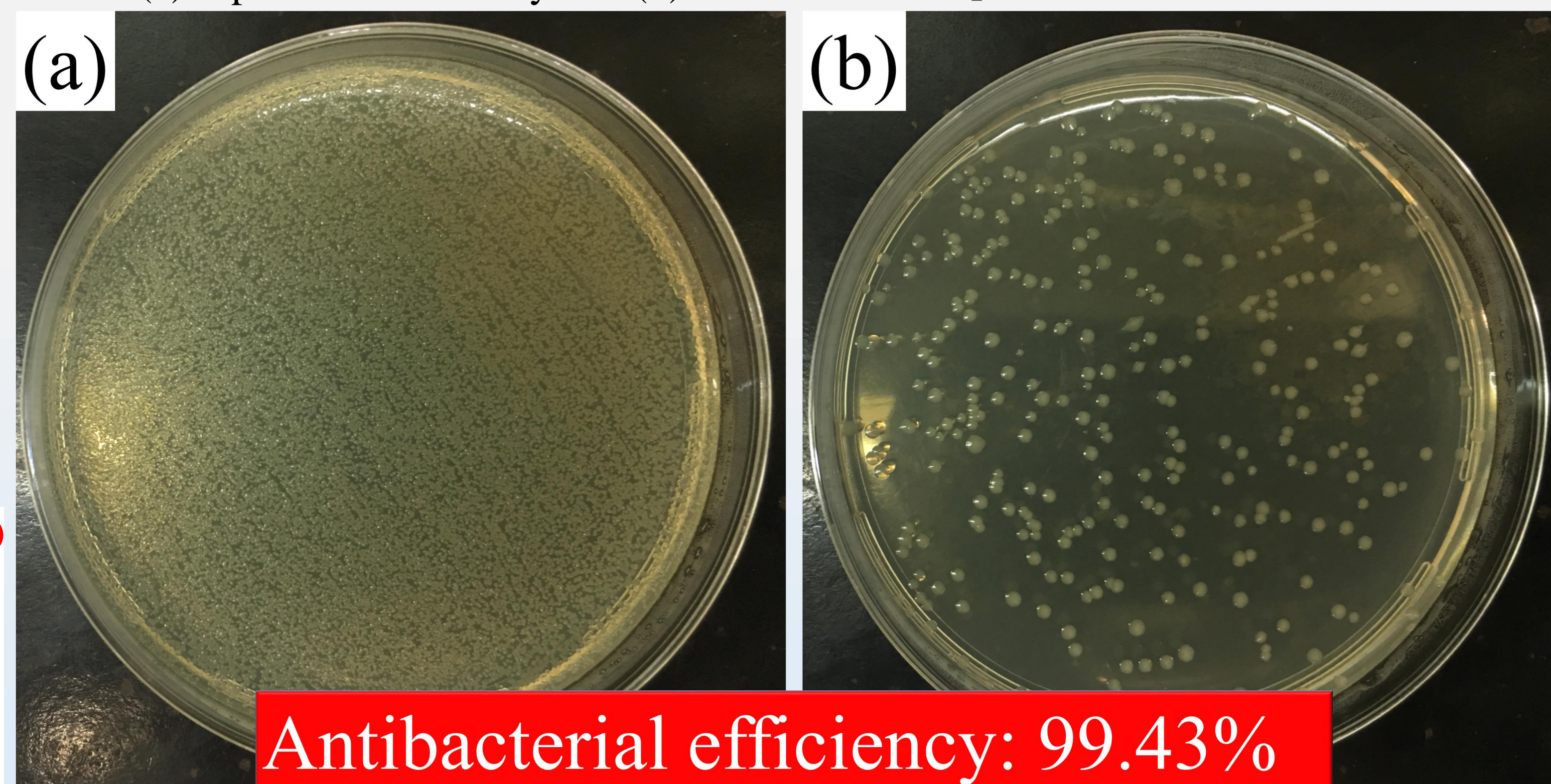


Fig.6 The *Escherichia coli* (*E. coli*) antibacterial effect of PMAPTAC-coated mesh. (a) Before filtration the number of *E. coli* is about 10⁶ CFU/ml. (b)After filtration the number of *E. coli* decreased to 5660 CFU/ml and the antibacterial efficiency is 99.43%.

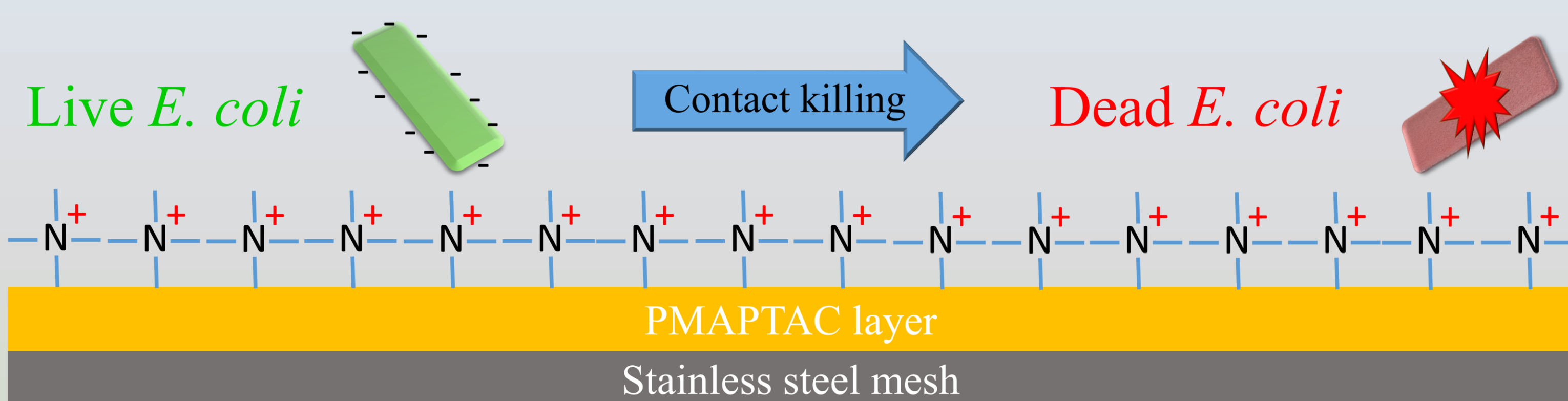


Fig.7 The schematic of antibacterial mechanism on PMAPTAC film.

Conclusion

- The PMAPTAC suited for oil-water separation membrane material, owing to low hydrolysis reaction and high conversion of 99% at polymerization time of 2.5 hours.
- Under the conditions of 300 mesh, the oil-water separation efficiency and separation flux can reach 99% and 4308 L h⁻¹m⁻², respectively.
- The oil-water separation efficiency can above 95%, under different acidic, alkali, salt, temperature and emulsion conditions.
- The antibacterial efficiency can above 99.43%.