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Surface modification of nanofibrous membranes for water purification

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ABSTRACT

Water covers approximately 70% of the earth's surface and is important for all living things. Yet, there is a serious lack of drinking water in many countries. Water treatment is becoming more important for world countries to tackle water scarcity by strengthening their infrastructure with the increase in global freshwater consumption. The aim of the project is to obtain nanofibrous membranes, which provide high fouling resistance and antibacterial properties for water purification.

Key words: nanofiber, membrane, surface, amine, modification

INTRODUCTION

It is well known that, some of nanoparticles, such as AgNPs, ZnO, CuO, TiO2, have antiseptical properties [1]. They may reduce growth ability of bacteria present in water, casue their irreversible damages in cells and disrupt cellular membrane structure [2]. The PVDF membranes were modified by alkaline agents such as KOH, NaOH, ethanoloamine and diethylenotriamine. Alkaline treatment degrade the PVDF and defluorization increase hydrophilicity, that reduce fouling [3]. In this research tried to remove fluoride from PVDF chain and add -OH and -NH2 groups, which in next step will be used to bound covalently nanoparticles.

MATERIALS & METHODS

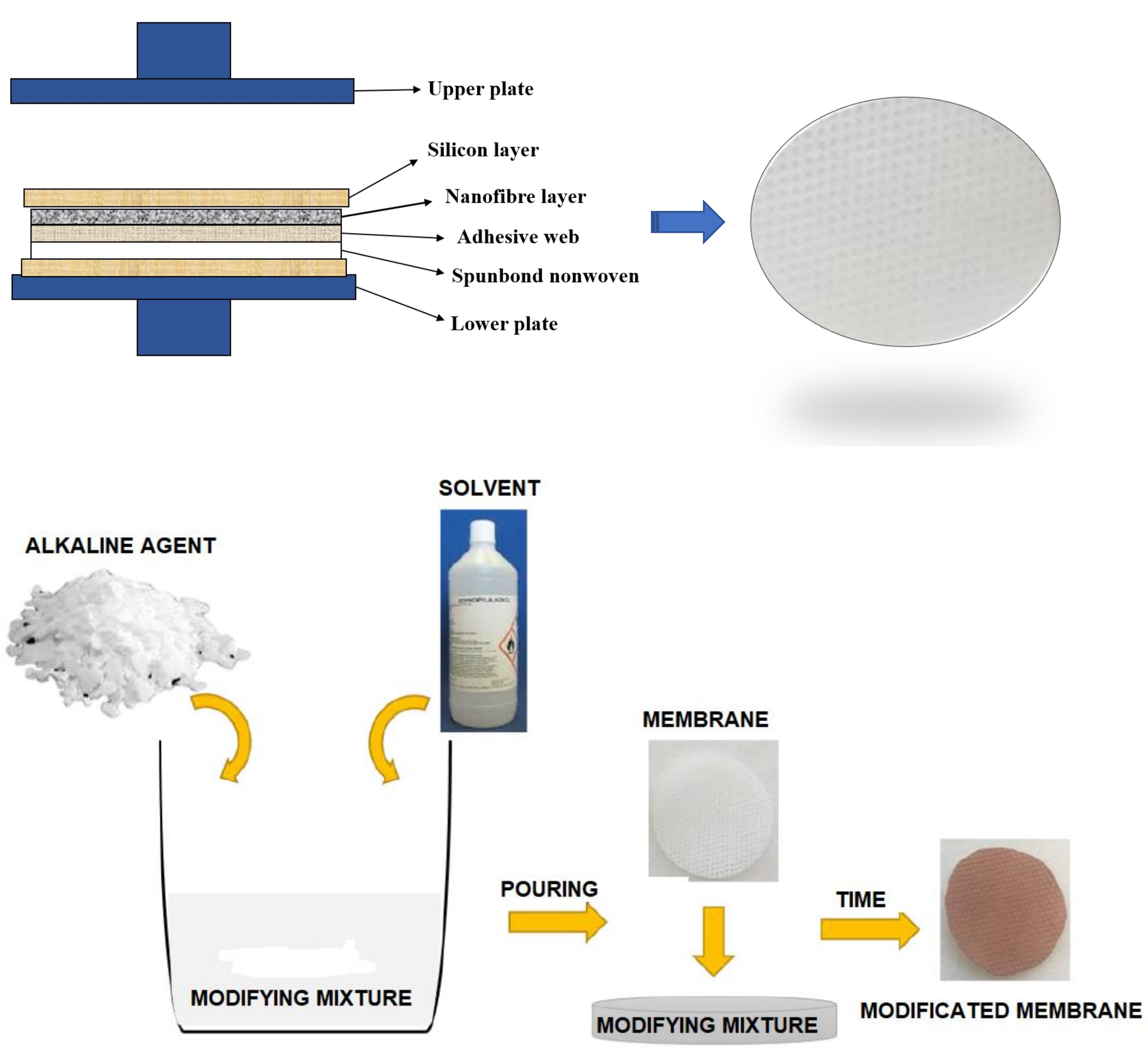

Figure 1: Membrane preparation and modification process

DISCUSSION & CONCLUSION

- Alkaline treatment increased the fiber diameter from 198 nm up to 300 nm. Similarly, membrane pore size reduced from 0.7 µm to 0.3-0.4 µm. (Figure 2)
- Modificaton improve membrane hydrophilicity (Figure 3) The contact angle in KOH modification decreased gradually whereas in others alkaline treatments reached 0^{o}C. (Figure 2)

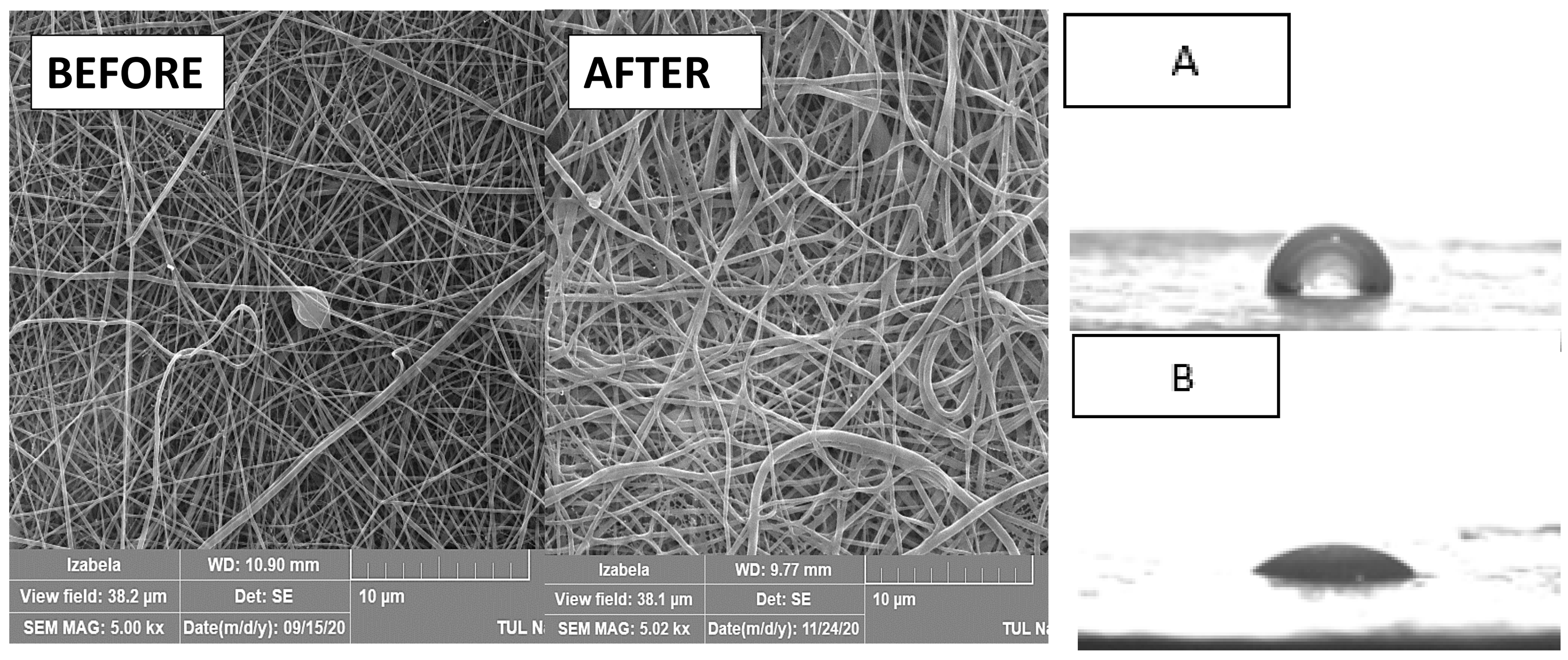

Figure 2: Changes of fiber diameter and hydrophilicity before and after modification

- Alkaline treatment by KOH and NaOH does not provide sufficient amount of -OH groups required for nanoparticles incorporation onto the surface of PVDF membranes. According to FTIR results small concentration of alkaline treatment initiated reaction of defluorization but do not complete it. The high concentration of alkaline agent causes damage of adhesive webs.

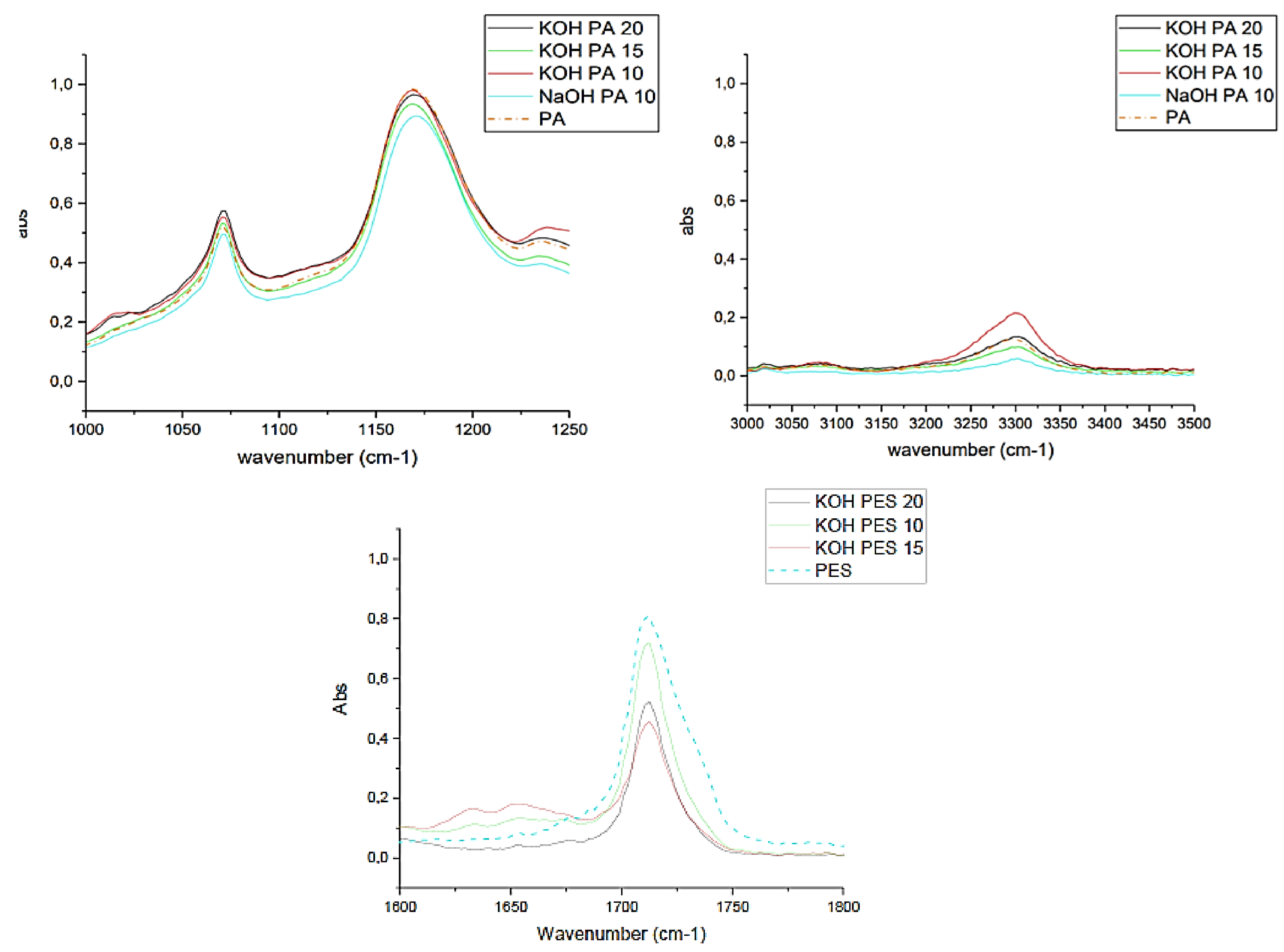

Figure 3: The FTIR spectrum after alkaline treatment for membranes

As future work, it is planned to decrease maximum concentration of amine agent, but increase reaction time. The alkaline modification by DETA provided small amount of -NH2 groups. However, it is essential to optimize reaction conditions.

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REFERENCES

[1] L. Wang, C. Hu, and L. Shao, “The antimicrobial activity of nanoparticles: present situation and prospects for the future,” Int. J. Nanomedicine, vol. 12, pp. 1227–1249, Feb. 2017, doi: 10.2147/IJN.S121956.

[2] J. Zhu et al., “Polymeric antimicrobial membranes enabled by nanomaterials for water treatment,” J. Membr. Sci., vol. 550, pp. 173–197, Mar. 2018, doi: 10.1016/j.memsci.2017.12.071.

[3] G. J. Ross, J. F. Watts, M. P. Hill, and P. Morrissey, “Surface modification of poly(vinylidene fluoride) by alkaline treatment1. The degradation mechanism,” Polymer, vol. 41, no. 5, pp. 1685–1696, Mar. 2000, doi: 10.1016/S0032-3861(99)00343-2.