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Ceramic membranes from dental zirconia waste

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Introduction

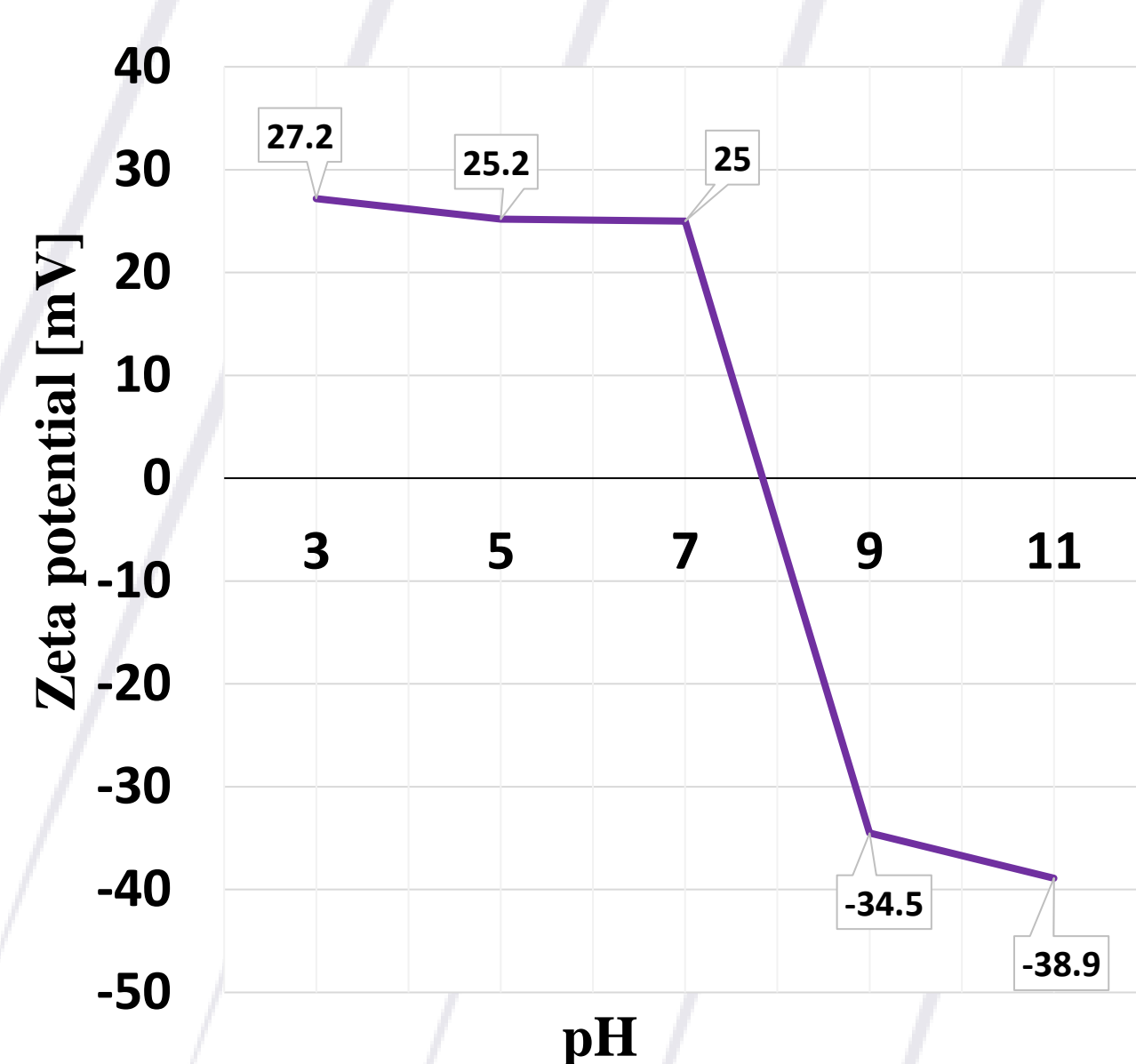
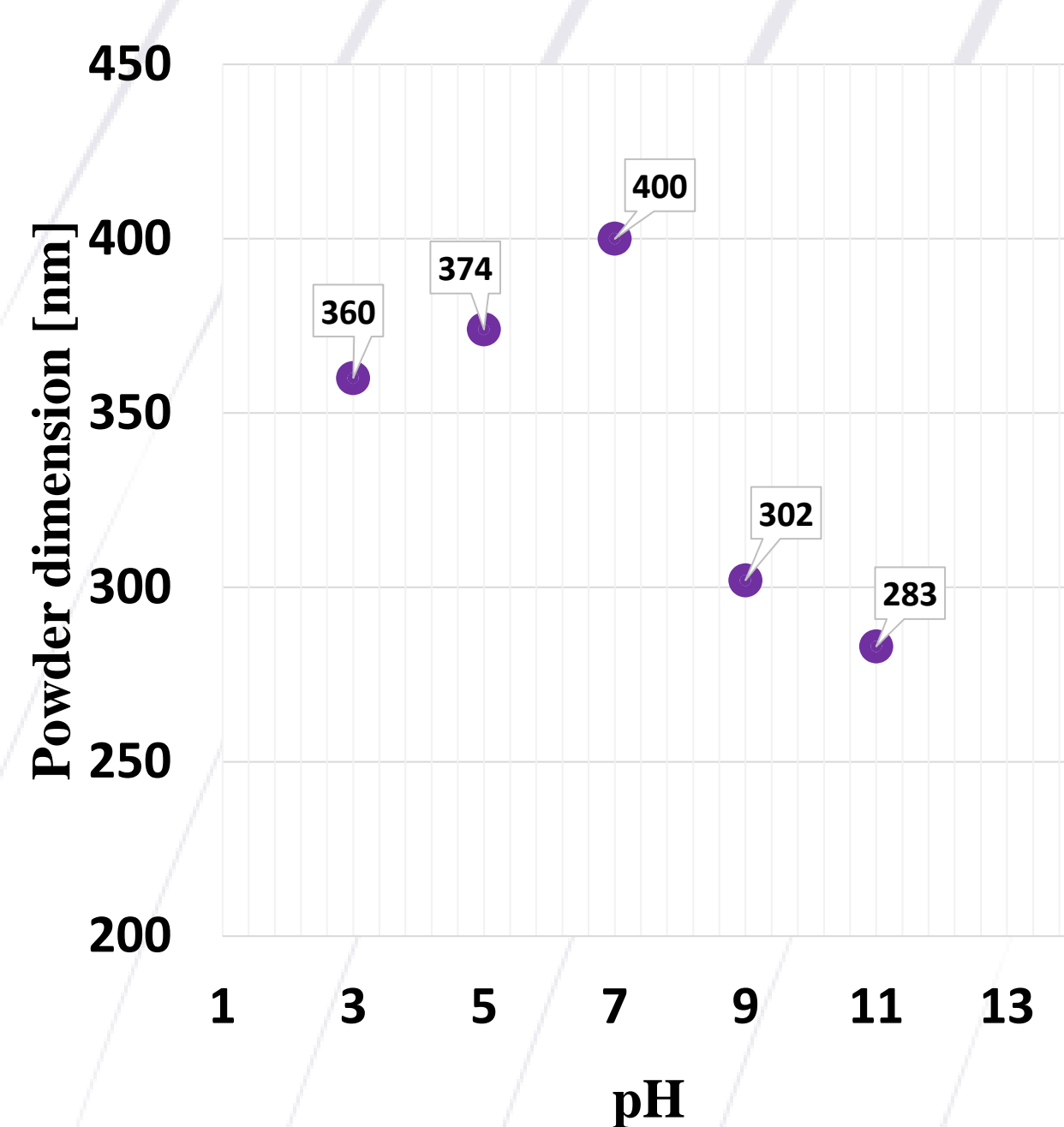
Zirconia-based ceramics are the most used materials for dental applications, due to important features, such as outstanding hardness, whiteness and chemical stability. During the machining of zirconia blocks to prepare the various types of prostheses, much of the **material** is **lost** as powder or lumps.

In this project, we **use** dental zirconia **waste** in the form of nanopowder to **fabricate** SiC **ceramic membrane** with high potential in the **removal** of **oil** residues from **produced water**.

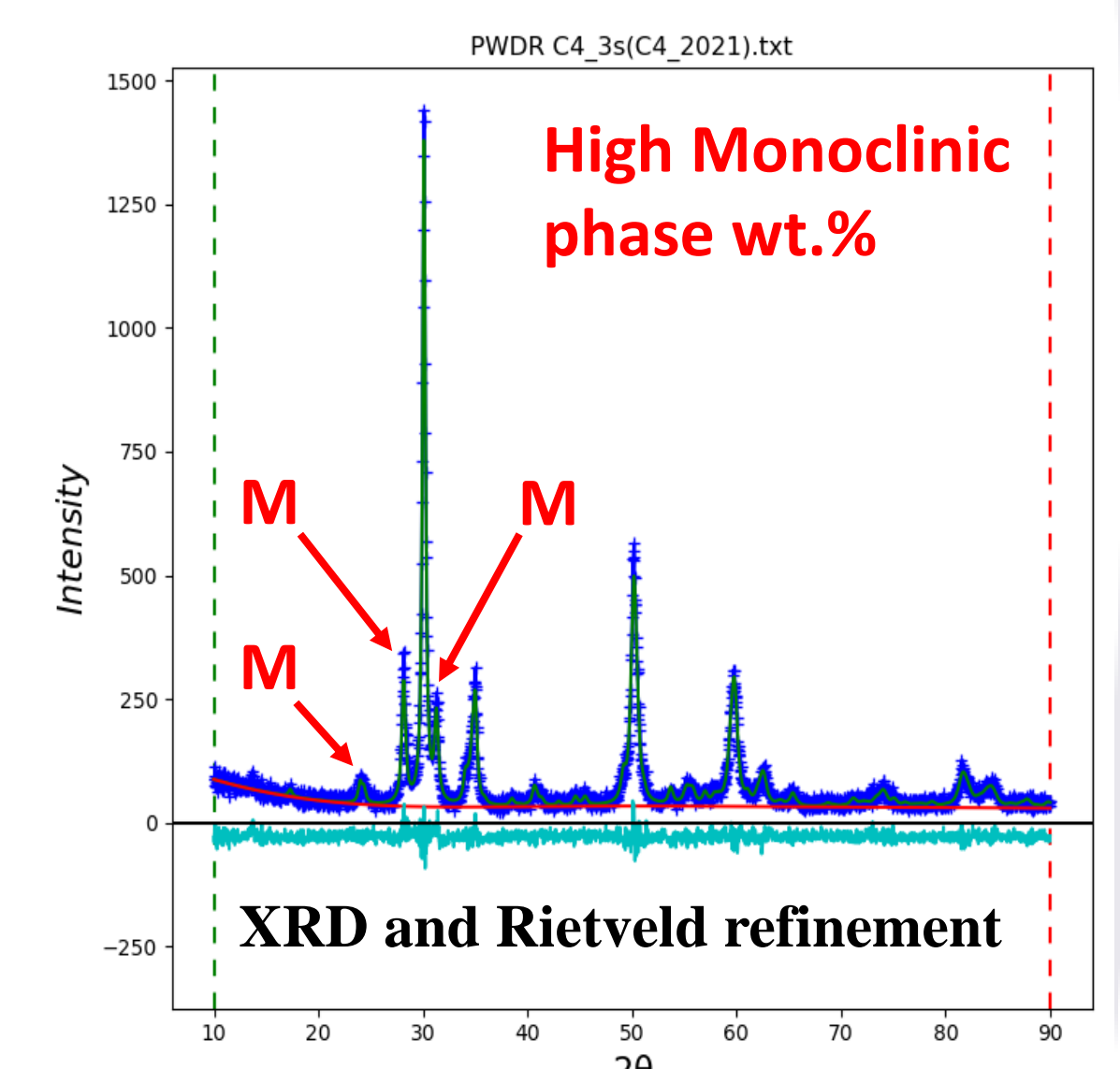
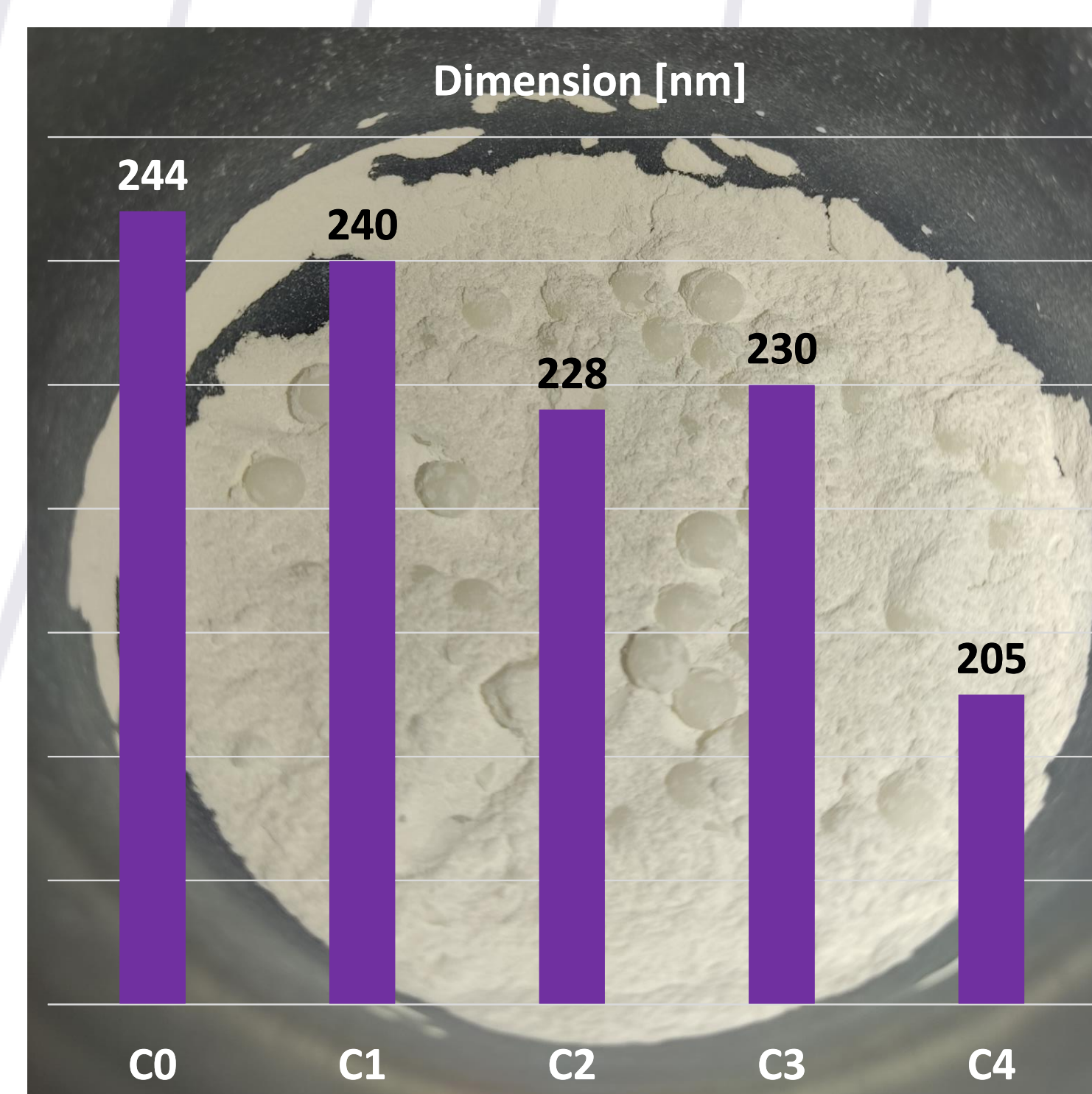


Powder Characterization

Dynamic Light Scattering (DLS) and **Zeta Potential** measurements were performed at different pH in order to evaluate dimension and stability behavior of the as received powder.



Ball milling was performed in order to **reduce** particles **dimensions** (DLS measurements).



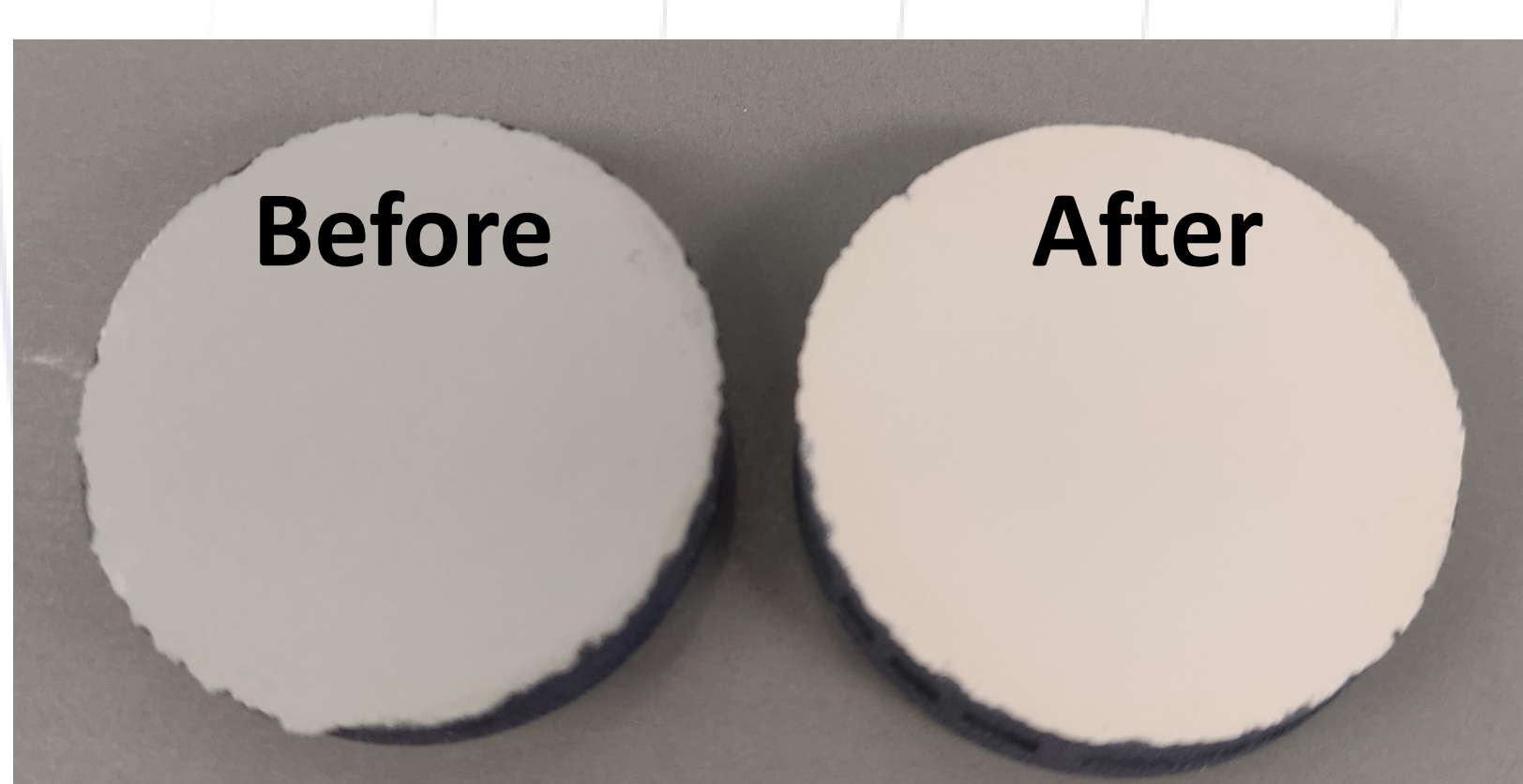
Chemical composition (wt.%)

- ZrO₂ + HfO₂ + Y₂O₃: ≥ 99.0
- Y₂O₃: 6,0 - 7,0
- HfO₂: ≤ 5
- Al₂O₃: ≤ 0.5
- Other oxides: ≤ 1

Membrane Fabrication and Filtration Test

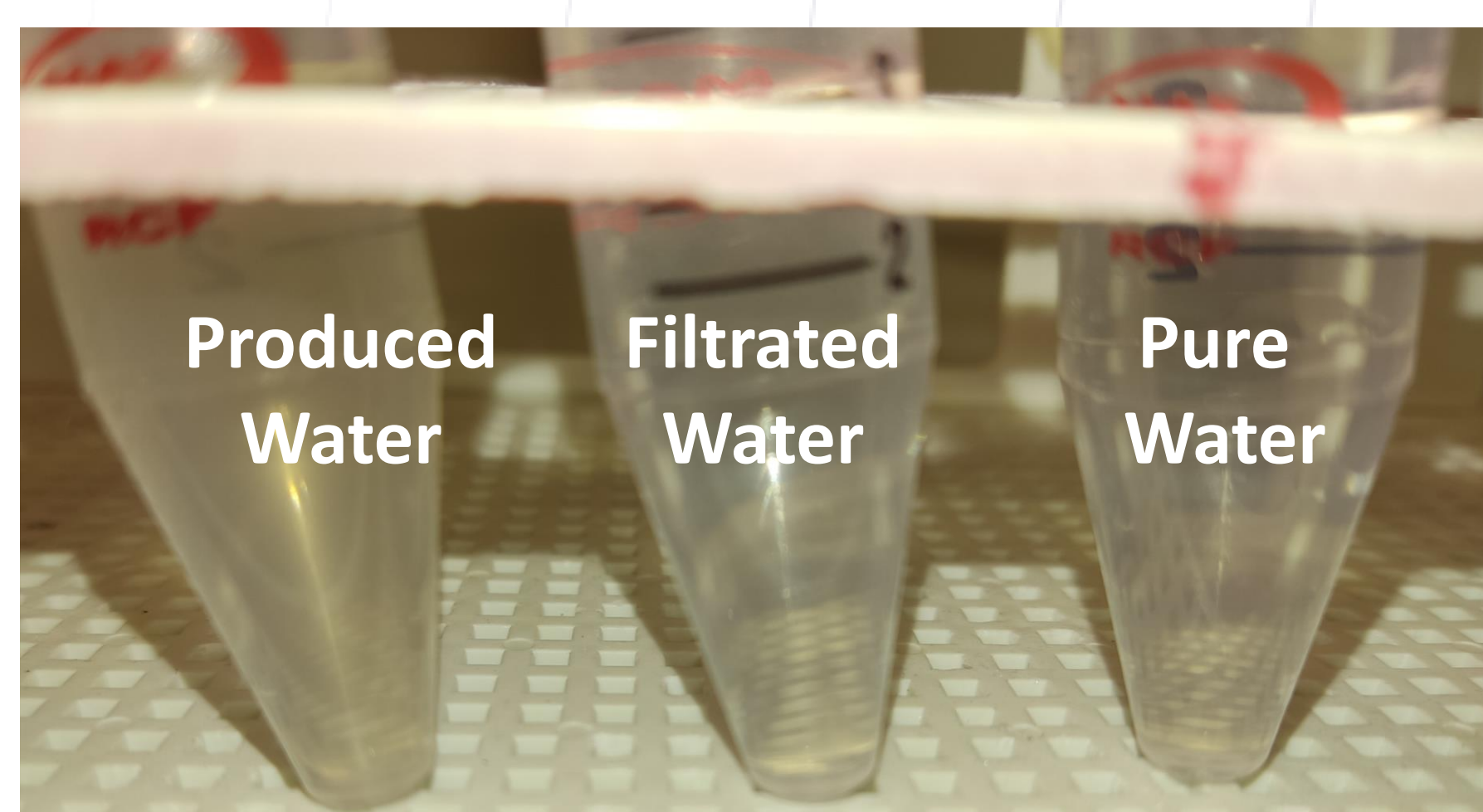
Spin Coating

SiC supports were spin coated with a dispersion of zirconia powder at **500 rpm** and different spin **coating time**.



Testing

Membranes were tested using a **sample** of Produced Water with 50 ppm of **crude oil**.



Oil Rejection

Results show that **only** about **10%** of oil passed through the membrane.

Spin Time	Oil loss
1'	91 %
10'	93%

Conclusion

Dental zirconia-based ultrafiltration membranes showed excellent oil retention effectiveness for the purification of produced water, giving as well a contribute to the industrial waste recycling issue. Further studies will be aimed at optimizing the deposition process of dental zirconia on the SiC membrane.

Acknowledgments

This work has been realized with the contribution of the Danish Hydrocarbon Research and Technology Centre (DHRTC) through the spring project "Blåtand" (RIS 2021). The authors also wish to thank Elisabetta Maschera and Roberto Putzolu (Laboratorio Odontotecnico Stardent Snc, Torino, Italy) for the dental zirconia waste, and Karen Guldbæk Schmidt (DHRTC-DTU) and Kristine Wille Hilstrøm (DHRTC-DTU) for their suggestions along the project.