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Effect of Conditions on TiO₂ Aerogel Crystallization Using Modified Supercritical Carbon Dioxide

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Titanium dioxide in the form of aerogels belongs to the most desirable materials due to its crystalline anatase structure exhibiting high photocatalytic activity. TiO₂ is used in the environmental applications such as air or water purification.¹

Crystalline and pure TiO₂ aerogels are prepared by the calcination, which is accompanied by uncontrollable destruction of the porous structure or a decrease in specific surface and porosity.² However, the thermal treatment has recently been successfully replaced by gentle low-thermal supercritical fluid crystallization (SFC) with modified supercritical carbon dioxide (scCO₂).³ In our previous studies,^{3–5} the efficiency of this method was demonstrated for TiO₂ in the forms of thin films and aerogels in which water and ethanol were used as modifiers. The critical effect of water on the TiO₂ crystallization and the beneficial influence of ethanol on the purity and phase composition of TiO₂ were found.

Therefore, this work is focused on a deeper study of TiO₂ aerogel SFC with scCO₂ modified by mixture of ethanol and water in a ratio 1:1. The effect of temperature (40–100 °C), pressure (10–30 MPa) and modifier concentration in scCO₂ (5–15 wt.%) on microstructure, purity and textural properties of TiO₂ aerogel was investigated. Processed monoliths were characterized by XRD analysis, Raman spectroscopy and N₂ physisorption.

Increasing temperature, pressure or modifier concentration in scCO₂ showed the positive effect on the aerogel purity. However, the temperature of 100 °C or the presence of too large amount of mixture (*i.e.* 15 wt.%) resulted into the aerogel destruction. Therefore, an optimal temperature and amount of mixture in scCO₂ in terms of the aerogel crystalline structure presence and sufficient purity was determined to be 80 °C and 10 wt.%. The increasing pressure led to the undesirable decrease of monolith specific surface area.

References

1. Chong, M. N.; Jin, B.; Chow, Ch. W. K.; Saint, Ch. Recent developments in photocatalytic water treatment technology: A review. *Water Res.* **2010**, *44*, 2997–3027.
2. Pourmand, M.; Mohammadizadeh, M. R. Influence of Temperature on TiO₂ Nanoparticles. *Curr. Nanosci.* **2008**, *4*, 151–156.
3. Sajfrtová, M.; Cerhová, M.; Dřínek, V.; Danis, S.; Matějová, L. Preparation of nanocrystalline titania thin films by using pure and water-modified supercritical carbon dioxide. *J. Supercrit. Fluids.* **2016**, *117*, 289–296.
4. Sajfrtová, M.; Cerhová, M.; Jandová, V.; Dřínek, V.; Daniš, S.; Matějová, L. The effect of type and concentration of modifier in supercritical carbon dioxide on crystallization of nanocrystalline titania thin films. *J. Supercrit. Fluids* **2018**, *133*, 211–217.
5. Cerhová, M.; Matějová, L.; Jandová, V.; Daniš, S.; Dřínek, V.; Sajfrtová, M. Preparation of nanocrystalline TiO₂ monoliths by using modified supercritical carbon dioxide. *J. Supercrit. Fluids* **2018**, *137*, 93–100.