



Title	Magneli-Phase Titanium Suboxide Nanocrystals as Highly Active Catalysts for Selective Acetalization of Furfural
Author(s)	Nagao, Masanori; Misu, Sayaka; Hirayama, Jun et al.
Citation	ACS applied materials & interfaces, 12(2), 2539-2547 https://doi.org/10.1021/acsami.9b19520
Issue Date	2020-01-15
Doc URL	https://hdl.handle.net/2115/80188
Rights	This document is the Accepted Manuscript version of a Published Work that appeared in final form in ACS applied materials & interfaces, copyright c American Chemical Society after peer review and technical editing by the publisher. To access the final edited and published work see https://pubs.acs.org/doi/10.1021/acsami.9b19520
Type	journal article
File Information	Supporting information.pdf



Supporting information

Magneli-phase titanium suboxide nanocrystals as highly active catalysts for selective acetalization of furfural

Masanori Nagao,^a Sayaka Misu,^a Jun Hirayama,^a Ryoichi Otomo,^{b,*} Yuichi Kamiya^{b,*}

^a *Graduate School of Environmental Science,* ^b *Faculty of Environmental Earth Science, Hokkaido University, Kita 10 Nishi 5, Sapporo 060-0810, Japan.*

**Corresponding author:*

Dr. Ryoichi Otomo

E-mail: otomo@ees.hokudai.ac.jp

Prof. Yuichi Kamiya

E-mail: kamiya@ees.hokudai.ac.jp

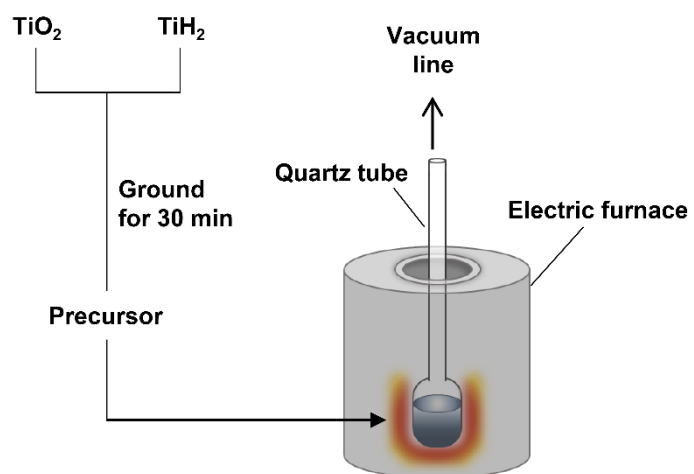


Figure S1. Experimental set up for synthesis of titanium suboxide under vacuum.

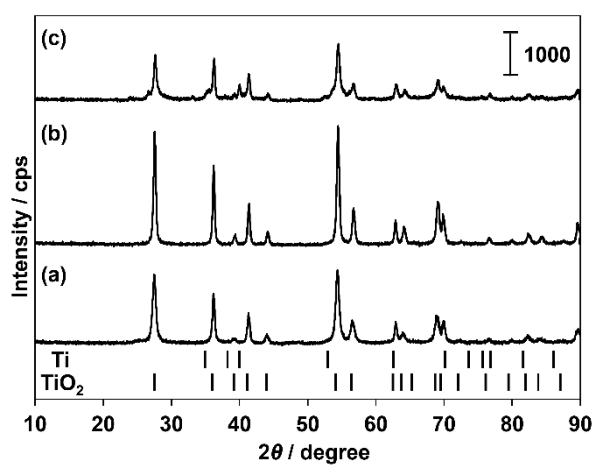


Figure S2. XRD patterns of (a) pristine TiO₂, (b) TiO₂ heated in H₂ flow at 600 °C for 5 h, and (c) TiO₂ heated with metallic Ti powder (TiO₂/Ti = 2) at 600 °C for 24 h.

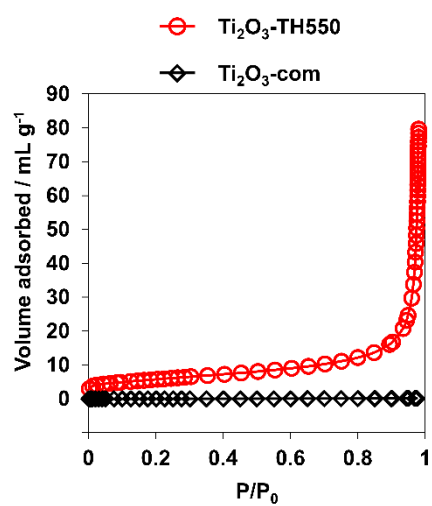


Figure S3. Nitrogen adsorption isotherms of $\text{Ti}_2\text{O}_3\text{-TH550}$ and $\text{Ti}_2\text{O}_3\text{-com}$.

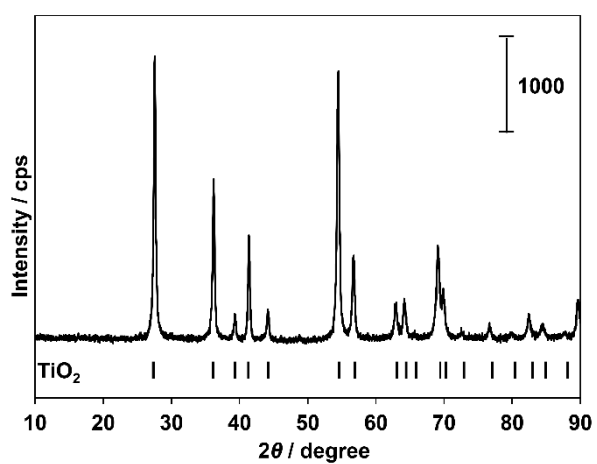


Figure S4. XRD pattern of Ti₂O₃-TH550 after calcination in air at 1000 °C.

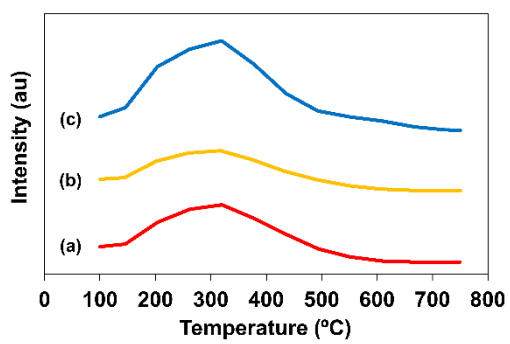


Figure S5. NH₃-TPD profiles of (a) Ti₂O₃-TH550, (b) Ti₂O₃-TH700, and (c) TiO₂-cal550.

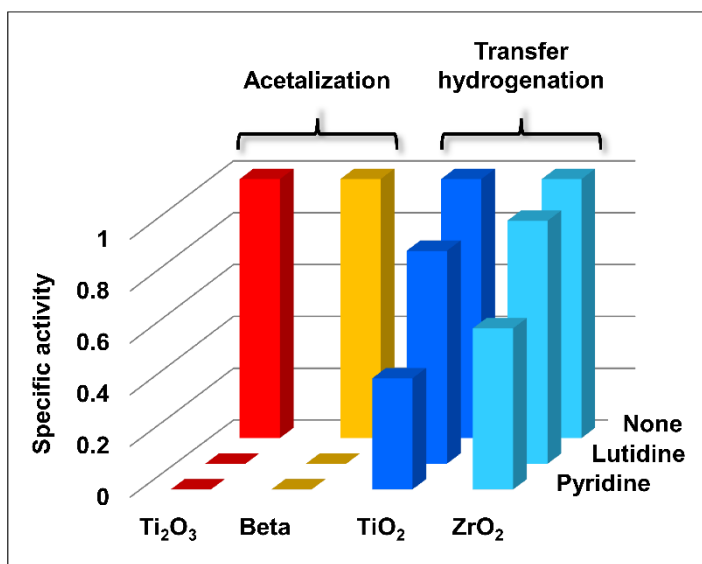


Figure S6. Specific activity of Ti_2O_3 -TH700, zeolite beta, TiO_2 -cal550, and ZrO_2 for reaction of furfural with 2-propanol in the presence of pyridine or 2,6-lutidine.

Reaction conditions: catalyst, 25 mg (TiO_2 , 100 mg); furfural, 0.5 mmol; 2-propanol, 5 mmol; toluene, 2.5 mL; pyridine, 1 mmol or lutidine, 0.5 mmol; temperature, 90 °C; time, 3 h.

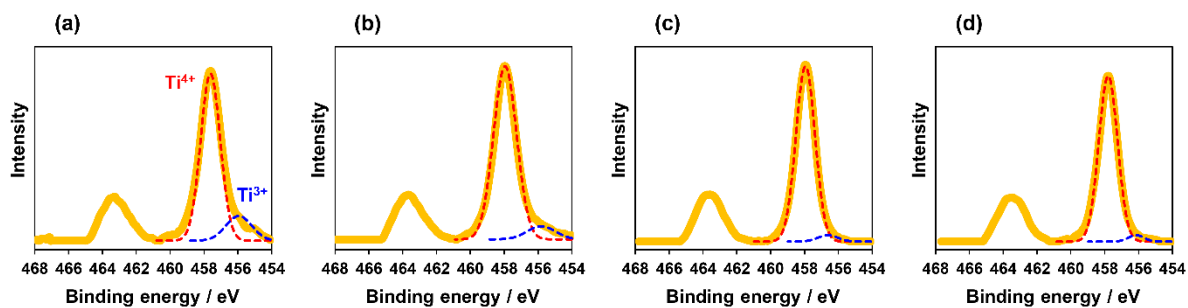


Figure S7. X-ray photoelectron spectra of Ti_2O_3 -TH700 after calcination in air at different temperatures for 0.5 h. (a) pristine, (b) 100 °C, (c) 400 °C, and (d) 700 °C.

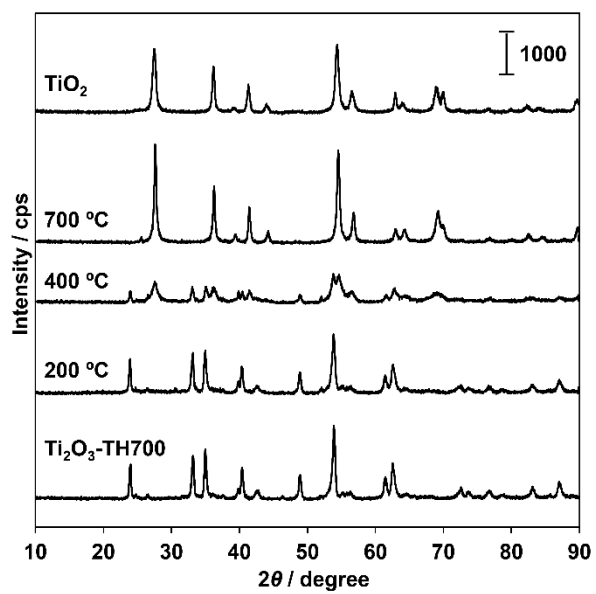


Figure S8. XRD patterns of $\text{Ti}_2\text{O}_3\text{-TH700}$ after calcination in air at different temperatures for 0.5 h.