

Supplementary material

Ti/Zr/O mixed oxides for the catalytic transfer hydrogenation of furfural to GVL in a liquid-phase continuous flow reactor

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1. CATALYST CHARACTERISATION

GC-FID calibration method

The solutions used to calibrate the GC used are stated in

Table S2, while the mothers solution from which the injected ones were taken are reported in Table S1.

Table S1. List of compounds used and their quantities for the mother solution.

Composto	Molecular Weight (g/mol)	Purity (%)	Theoretical concentration (mol/l)	Flask volume (ml)	Theoretical mass (g)
Furfural	96.09	100	0.5	5	0.2402
Furfuryl Alcohol	98.10	98	0.5		0.2503
α/β - angelica lactone	98.10	98	0.5		0.2503
Propyl Levulinate	158.19	95	0.5		0.4163
GVL	100.12	99	0.5		0.2528
Furfuryl Ethyl Ether	126.15	98	0.5		0.3218

Table S2. Concentrations of the standards prepared for each individual compound from its mother solution.

	Theoretical concentration (mol/l)	Flask volume (ml)	Taking volume (ml)	Octane volume added (μ l)
Standard 1	0.05	25	2.5	20
Standard 2	0.03	25	1.5	20
Standard 3	0.015	25	0.75	20
Standard 4	0.0002	25	0.01	20

XRD patterns of zirconia at different calcination temperatures

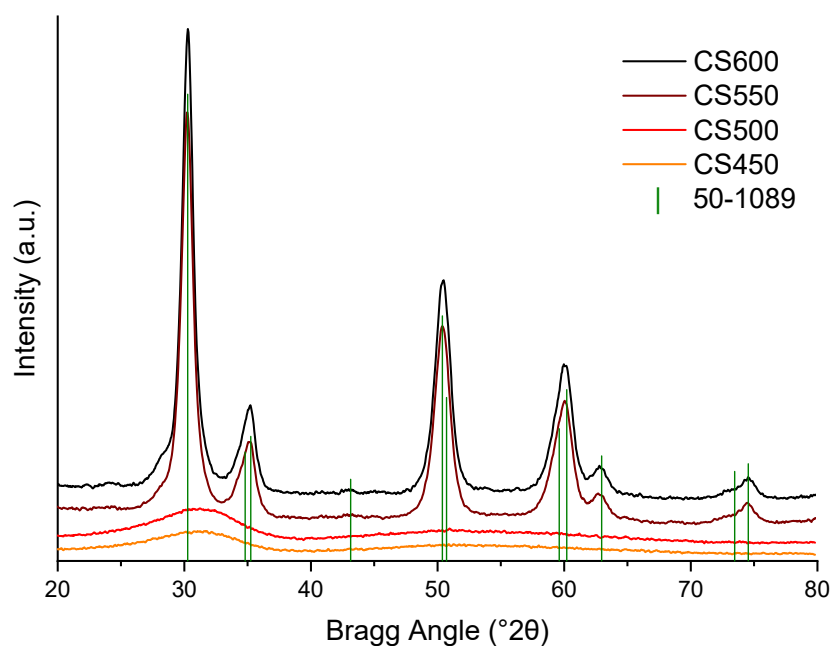


Figure S1. XRD patterns of the synthesized zirconia calcined at different temperatures (from 450 $^{\circ}\text{C}$ to 600 $^{\circ}\text{C}$, as indicated by the labels 'CSXXX' where XXX corresponds to the temperature in $^{\circ}\text{C}$). In green, the reference pattern of tetragonal zirconia from PDF 50-1089. The red profile is the one relative to the sample used in this study.

XRD comparison between fresh and used catalysts

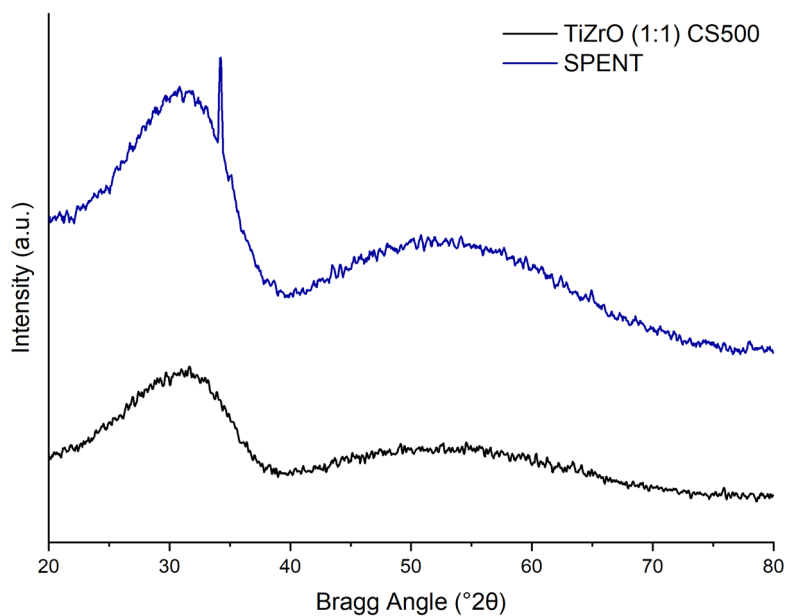


Figure S2. XRD patterns of catalyst before and after reaction Ti/Zr/O (1:1).

N₂ adsorption–desorption isotherms and pore size distribution **-Ti/Zr/O (1:1)**

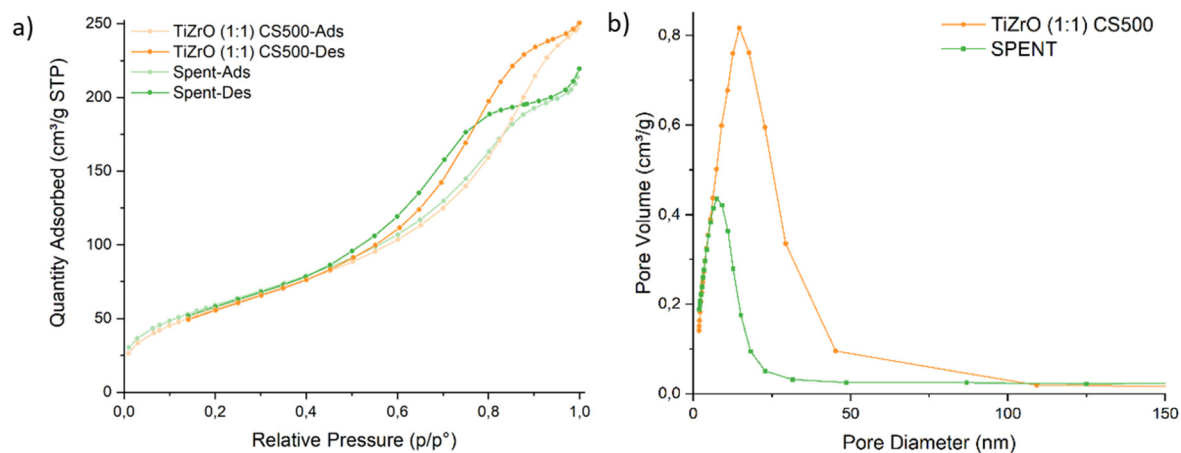


Figure S3. (a) N₂ adsorption–desorption isotherms and (b) pore size distribution of Ti/Zr/O (1:1) before and after (SPENT) reaction.

Catalytic tests

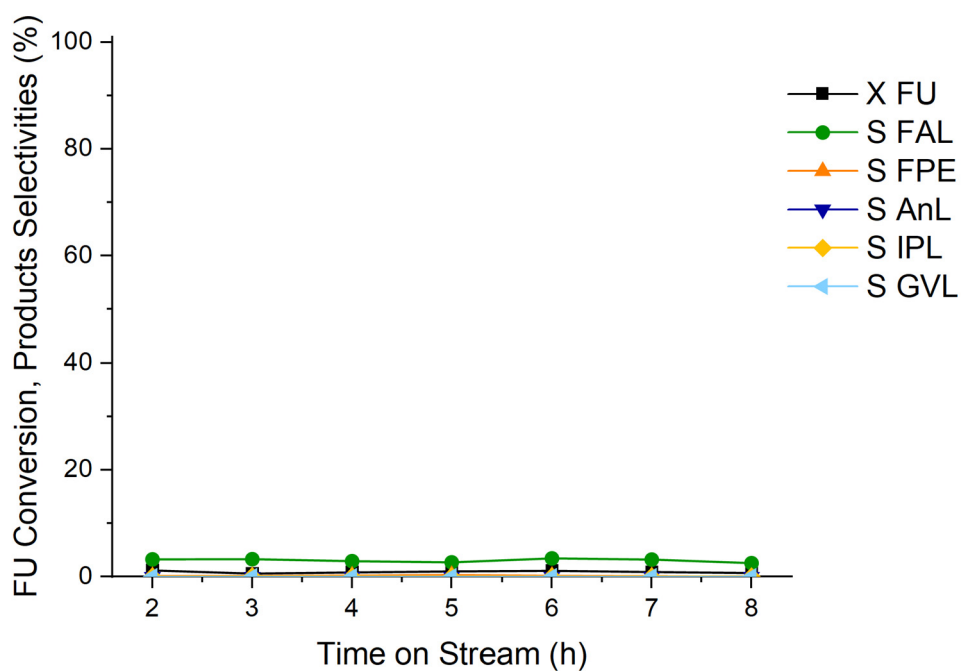


Figure S4. Furfural conversion and product selectivities (%) as a function of time (h) using SiC. Reaction conditions: [FU] = 67 mM, τ = 10 min, T = 180 °C, mcat = 0.75g.

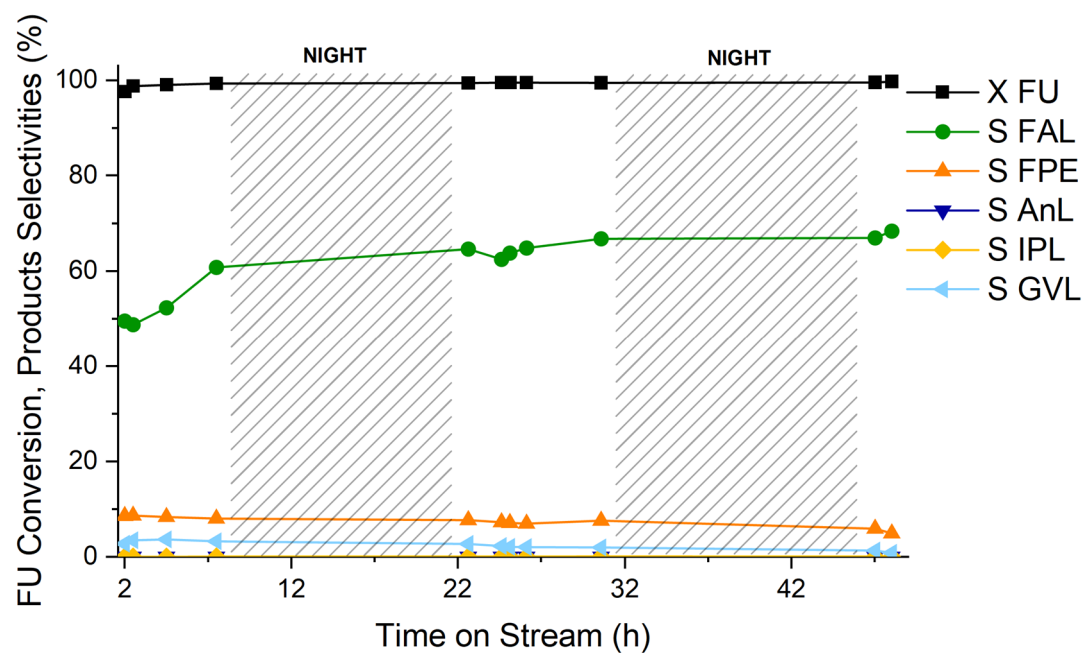


Figure S5. Furfural conversion and product selectivities (%) as a function of time (h) using ZrO₂. Reaction conditions: [FU]=67 mM, τ = 10 min, T= 180 °C, mcat = 0.86g.

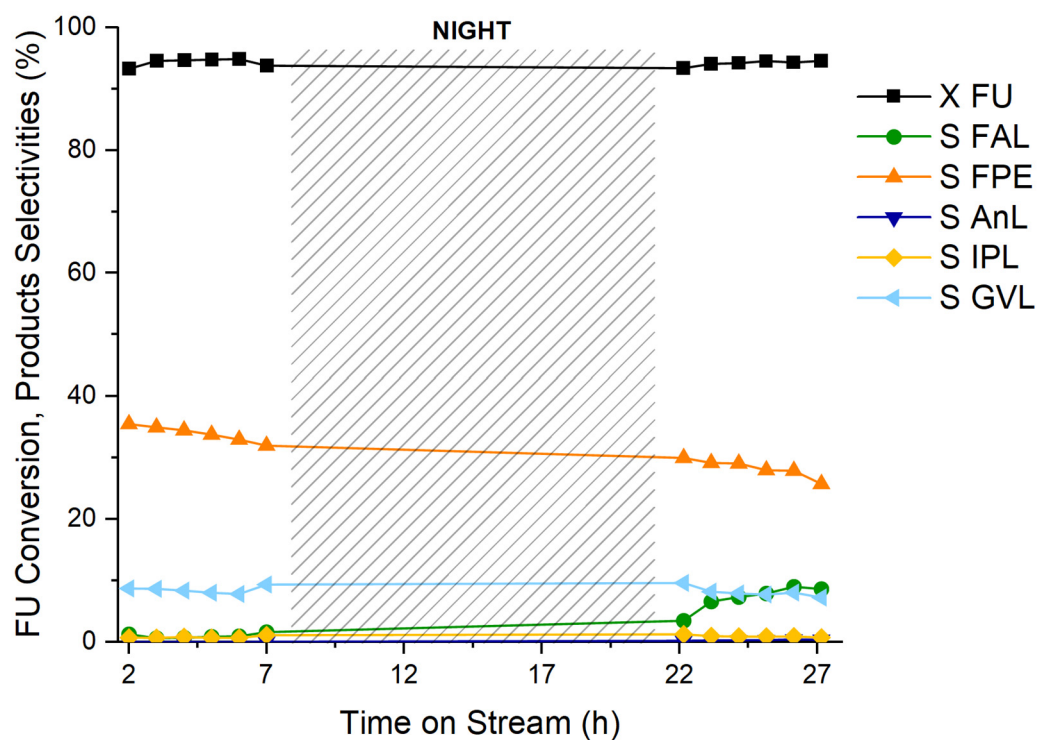


Figure S6. Furfural conversion and product selectivities (%) as a function of time (h) using TiO₂. Reaction conditions: [FU]= 67 mM, τ = 10 min, T= 180 °C, mcat = 0.97g.

