

## Supplementary material

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

Anna Saotta<sup>1,2</sup>, Alessandro Allegri<sup>1,2</sup>, Francesca Liuzzi<sup>1,2</sup>, Giuseppe Fornasari<sup>1,2</sup>, Nikolaos Dimitratos<sup>1,2</sup>, Stefania Albonetti<sup>1,2\*</sup>

1. Department of Industrial Chemistry "Toso Montanari", University of Bologna, Viale Risorgimento 4, Bologna 40136, Italy.
2. Center for Chemical Catalysis-C3, Alma Mater Studiorum Università di Bologna, Viale Risorgimento 4, Bologna 40136, Italy.

#### 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.

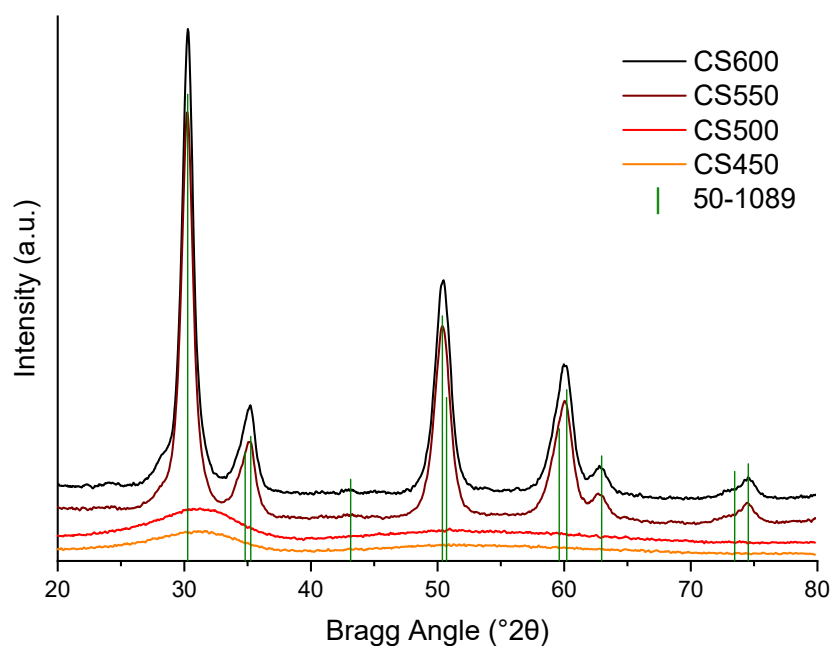
Table S1. List of compounds used and their quantities for the mother solution.

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

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

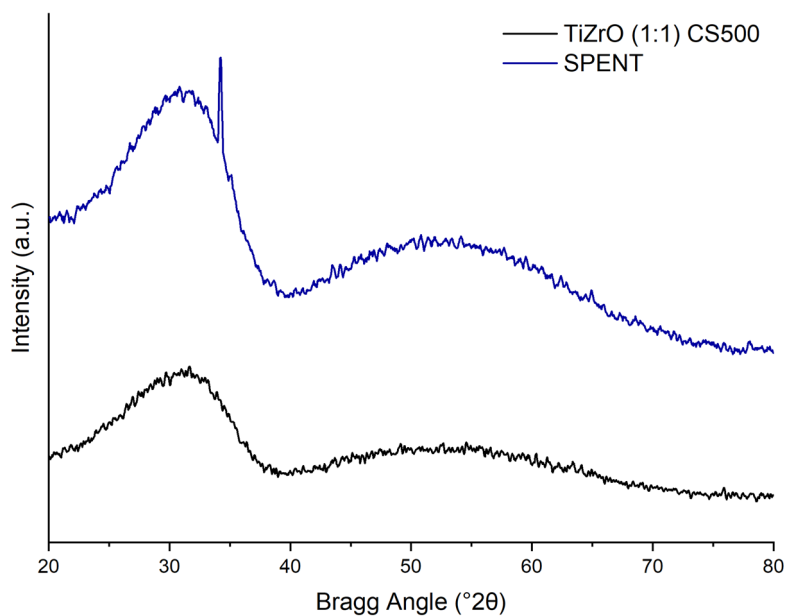
	<i>Theoretical concentration (mol/l)</i>	<i>Flask volume (ml)</i>	<i>Taking volume (ml)</i>	<i>Octane volume added (μl)</i>
<i>Standard 1</i>	0.05	25	2.5	20
<i>Standard 2</i>	0.03	25	1.5	20
<i>Standard 3</i>	0.015	25	0.75	20
<i>Standard 4</i>	0.0002	25	0.01	20

### ***XRD patterns of zirconia at different calcination temperatures***



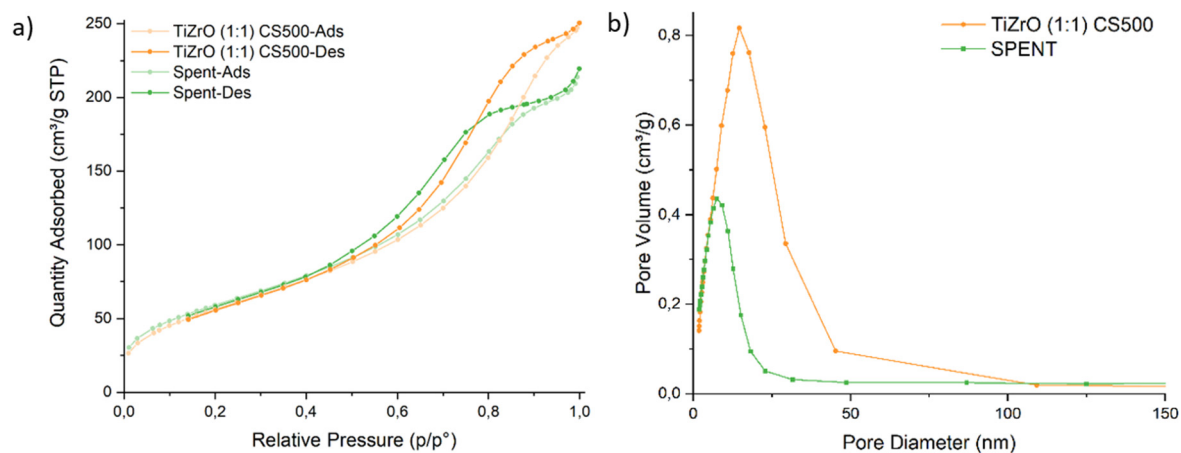
**Figure S1.** XRD patterns of the synthesized zirconia calcined at different temperatures (from 450 °C to 600 °C, as indicated by the labels 'CSXXX' where XXX corresponds to the temperature in °C). In green, the reference pattern of tetragonal zirconia from PDF 50-1089. The red profile is the one relative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

### ***XRD comparison between fresh and used catalysts***



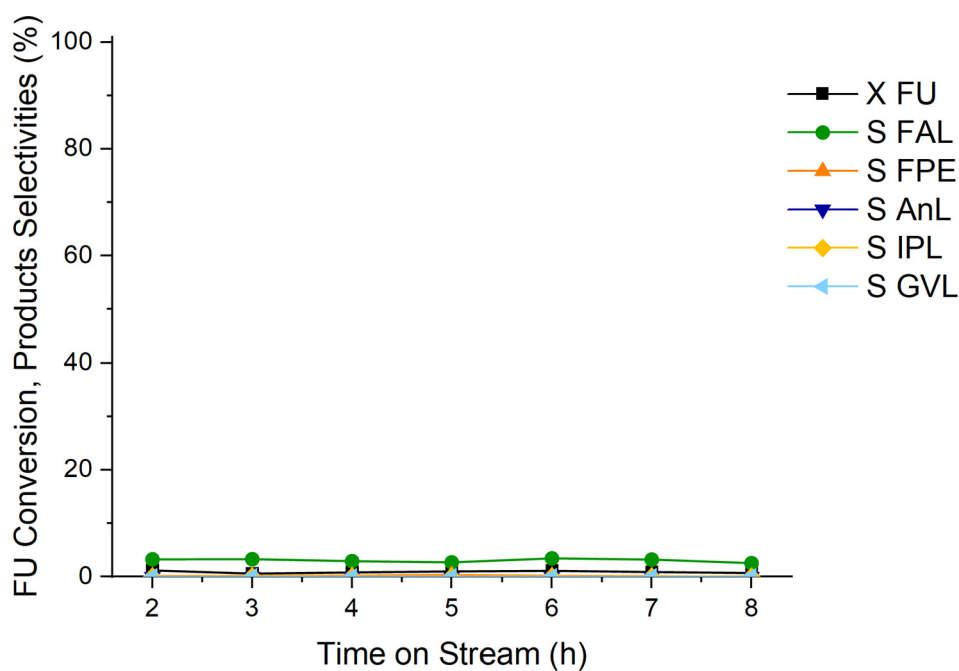
**Figure S2.** XRD patterns of catalyst before and after reaction Ti/Zr/O (1:1).

## ***N<sub>2</sub>* adsorption–desorption isotherms and pore size distribution -Ti/Zr/O (1:1)**

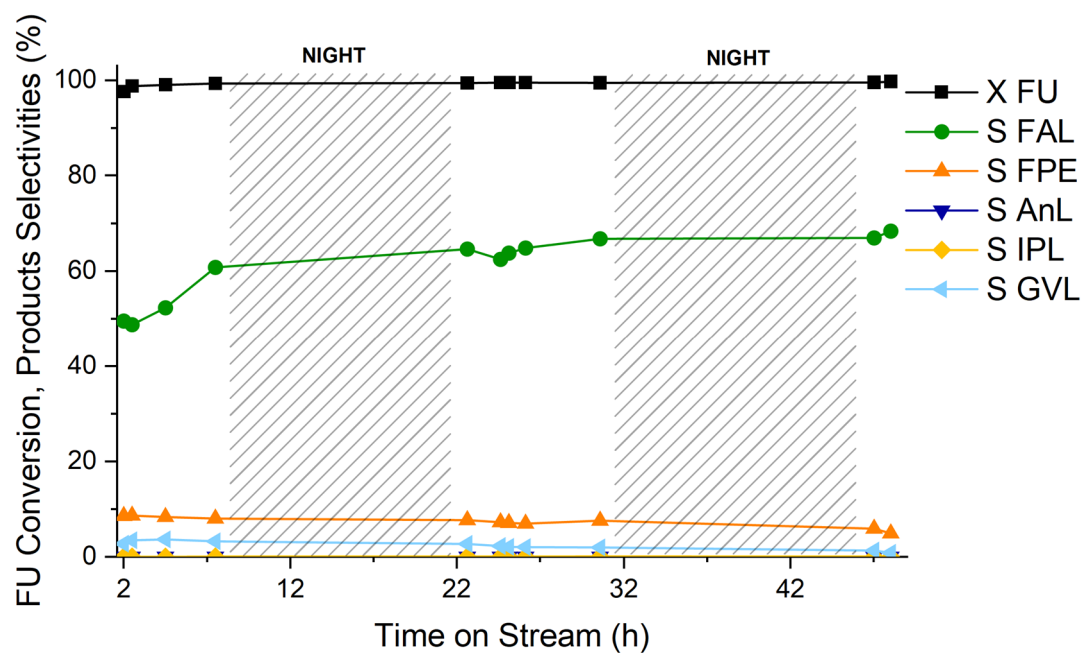


**Figure S3.** (a) N<sub>2</sub> adsorption–desorption isotherms and (b) pore size distribution of Ti/Zr/O (1:1) before and after (SPENT) reaction.

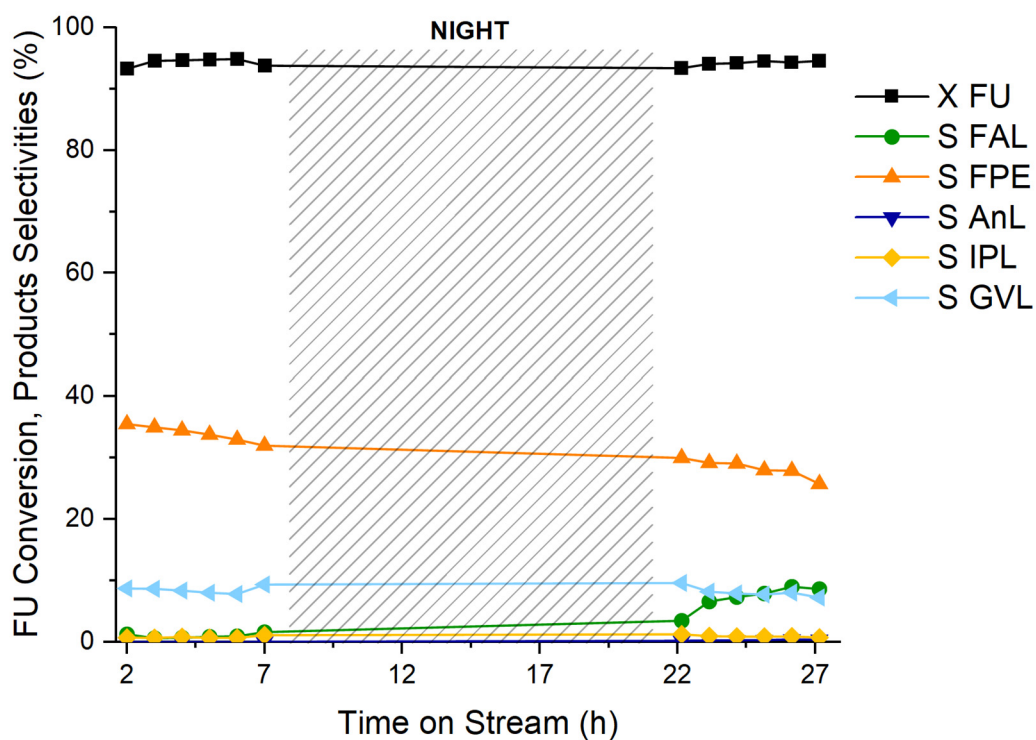
## **Catalytic tests**



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



**Figure S5.** Furfural conversion and product selectivities (%) as a function of time (h) using ZrO<sub>2</sub>. Reaction conditions: [FU]=67 mM,  $\tau$ = 10 min, T= 180 °C, mcat = 0.86g.



**Figure S6.** Furfural conversion and product selectivities (%) as a function of time (h) using TiO<sub>2</sub>. Reaction conditions: [FU]= 67 mM,  $\tau$ = 10 min, T= 180 °C, mcat = 0.97g.

