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#### **Supporting Information**

# Promotion effects of Pd on tungsten carbide catalysts: physiochemical properties and cellulose conversion performance

Glauco F. Leal<sup>a,b</sup>, Silvia F. Moya<sup>a</sup>, Debora M. Meira<sup>a,c</sup>, Dean H. Barrett<sup>a</sup>,

Erico Teixeira-Neto<sup>d</sup>, Antonio Aprígio S. Curvelo<sup>b,e</sup>, Victor Teixeira da Silva<sup>f</sup> and

Cristiane B. Rodella<sup>a</sup>

<sup>a</sup> Brazilian Center for Research in Energy and Materials (CNPEM) - Brazilian Synchrotron Light Laboratory (LNLS), C. P. 6192, 13083-970, Campinas, SP, Brazil

<sup>b</sup> Institute of Chemistry of São Carlos (IQSC)/University of São Paulo (USP)/ C.P. 780, CEP 13560-970, São Carlos, SP, Brazil

<sup>c</sup> European Synchrotron Radiation Facility (ESRF), 71 Avenue des Martyrs, 38000 Grenoble, France

<sup>d</sup> CNPEM – Brazilian Nanotechnology National Laboratory (LNNano)-CNPEM, CP 6192, CEP 13083-970, Campinas, SP, Brasil

<sup>e</sup> CNPEM - Brazilian Bioethanol Science and Technology Laboratory (CTBE), C. P. 6192, 13083-970, Campinas, SP, Brazil

<sup>f</sup> Universidade Federal do Rio de Janeiro/COPPE/Chemical Engineering Program/NUCAT, P.O. Box 68502, Rio de Janeiro, RJ 21945-970, Brazil

\*Corresponding author: cristiane.rodella@lnls.br Phone: +55 19 3512 1040 FAX: +55 19 3512 1004

#### 1. Adsorption-Desorption Isotherms



Figure S1. Adsorption-desorption isotherms of tungsten carbide catalysts supported on commercial carbon: a) C (commercial carbon); b)  $W_XC/C$ ; c) 1Pd- $W_2C/C$ ; d) 2Pd- $W_2C/C$ .



Figure S2: Pore size distribution determine by BJH method of the catalysts.

#### 2. Mass Spectrometry

Water, carbon monoxide, carbon dioxide and methane formation profiles for the tungsten carbides catalysts obtained during the carburization process. Some of the mass spectrometer signals were multiplied by a factor, showed on the left side of each profile, to allow for better visualization and comparison of the signals.



Figure S3. Mass spectrometer profile of the carburization synthesis of the non-promoted tungsten carbide catalyst ( $W_xC/C$ ).



**Figure S4.** Mass spectrometer profile of the carburization synthesis of the 1wt.% of Pdpromoted tungsten carbide catalyst (1Pd- $W_2C/C$ ).



**Figure S5.** Mass spectrometer profile of the carburization synthesis of the 2wt.% of Pd-promoted tungsten carbide catalyst (2Pd-W<sub>2</sub>C/C).

#### 3. EXAFS



**Figure S6.** Phase uncorrected FT of the experimental EXAFS spectra of the 1Pd- $W_2C/C$  and 2Pd- $W_2C/C$  samples. Experimental data is in black, red solid lines are the corresponding best fits, calculated in the radial distance window colored in blue.

4. XPS



**Figure S7**. W 4f XPS spectra of the tungsten carbides catalysts: a) non-promoted sample  $W_xC/C$ ; b) 1%Pd-W<sub>2</sub>C/C and c) 2%Pd-W<sub>2</sub>C/C. Experimental signal: solid curve; deconvoluted signal and fitting: dash curve.



**Figure S8.** Pd 3d XPS spectra of the Pd-promoted tungsten carbides catalysts: a) 1%Pd- $W_2C/C$  and b) 2%Pd- $W_2C/C$ . Experimental signal: solid curve; deconvoluted signal and fitting: dash curve.



Figure S9. TEM images of the tungsten carbides catalysts.

## 6. XEDS chemical maps



25nm



Figure S10: EDX analysis with W and Pd mapping of two catalyst particles.

### 7. Catalytic tests



Figure S11: Sequence of four runs of catalytic reactions over  $2Pd-W_2C/C$  catalyst. Reaction conditions: 150mL of deionized water, 1,0g of Avicel microcrystalline cellulose Merck , 0.300g of catalyst, 220°C, 120 min, 5.8 MPa of H<sub>2</sub> and 1000 rpm, respectively.



Figure S12: XRD analysis of  $1PdW_2C/C$  catalyst before and after the recycling reactions.