materials

MDPI

Supplementary Materials

The Effect of the ZrO_2 Loading in SiO_2@ZrO_2-CaO Catalysts for Transesterification Reaction

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Table 1. Surface area of the SiO_2@ZrO_2 core@shell without calcination (fresh samples).

Catalyst	BET Surface Area ($m^2 g^{-1}$)
SiO_2 spheres	17
SiO_2@ZrO_2 0.04M	153
SiO_2@ZrO_2 0.06M	192
SiO_2@ZrO_2 0.08M	150
SiO_2@$ZrO_2$0.04M-CaO	n.d
SiO_2@$ZrO_2$0.06M-CaO	n.d
SiO_2@$ZrO_2$0.08M-CaO	n.d

Table 2. Fatty acid composition of the canola oil.

Fatty Acid Composition	Composition of Canola Oil, wt %
Palmitic (C16:0)	4.4
Oleic (C18:1)	55
Linoleic (C18:2)	31
Linolenic (C18:3)	7.8

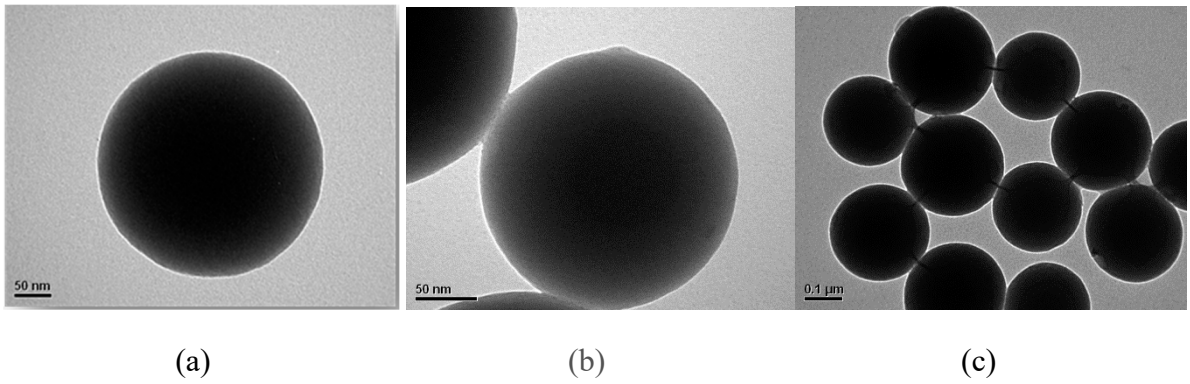


Figure 1. TEM images (**a**) SiO_2 sphere; (**b**) SiO_2 sphere—500°C; (**c**) SiO_2 sphere—700°C.

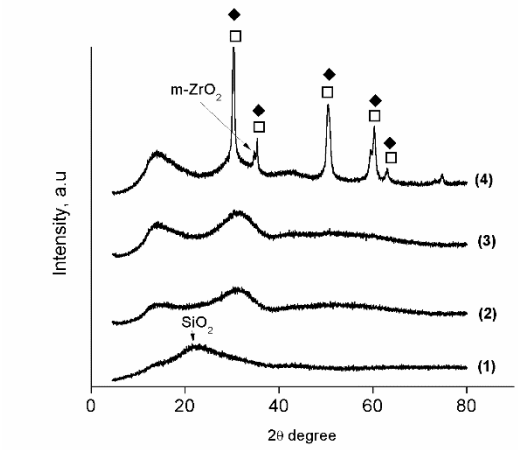


Figure 2. XRD profiles of SiO_2 sphere (1) and core@shell SiO_2@ZrO_2 0.04M (2), SiO_2@ZrO_2 0.06M (3) and SiO_2@ZrO_2 0.08M (4) calcined at 500 °C.

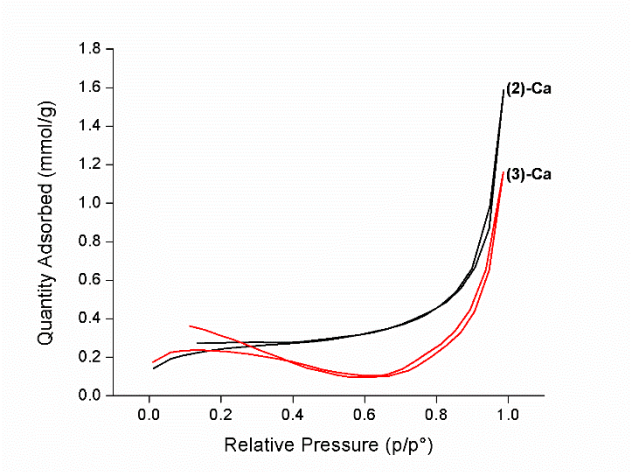


Figure 3. N_2 adsorption-desorption isotherms of (2)-Ca: SiO_2@ZrO_2 0.06M-CaO, (3)-Ca: SiO_2@ZrO_2 0.08M-CaO calcined at 700°C.

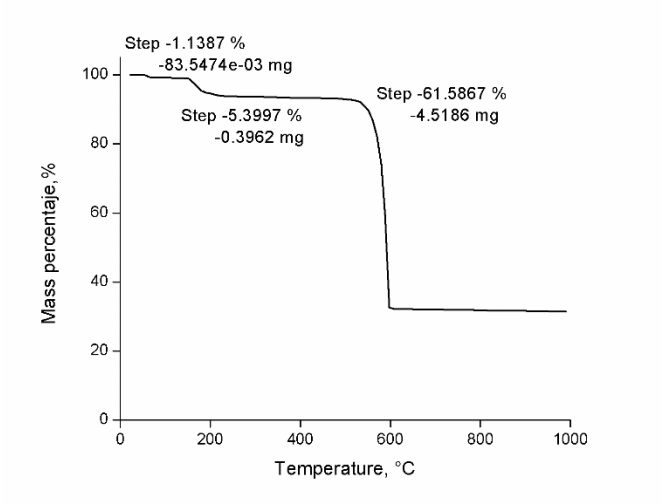
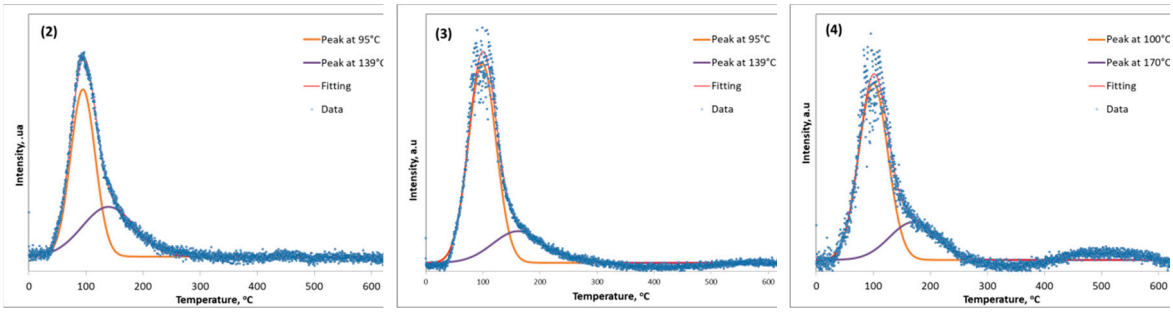
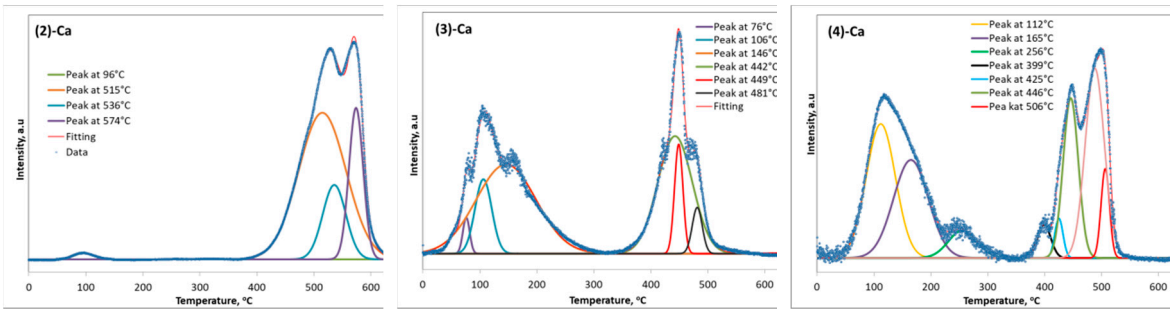


Figure 4. TGA of $CaNO_3 \cdot 4H_2O$.



(a) **(b)** **(c)**

Figure 5. CO_2 temperature-programmed desorption profiles of SiO_2@ZrO_2 0.04M (2), SiO_2@ZrO_2 0.06M (3) and SiO_2@ZrO_2 0.08M (4) at 700 °C. Software Fityk for deconvolution and Levenberg-Marquardt method for peak fitting, (**a**) SiO_2@ZrO_2 0.04M; (**b**) SiO_2@ZrO_2 0.06M and (**c**) SiO_2@ZrO_2 0.08M.



(a) **(b)** **(c)**

Figure 6. CO_2 temperature-programmed desorption profiles of SiO_2@ZrO_2 0.04M-CaO (2)-Ca, SiO_2@ZrO_2 0.06M-CaO (3)-Ca and SiO_2@ZrO_2 0.08M-CaO (4)-Ca at 700 °C. Software Fityk for deconvolution and Levenberg-Marquardt method for peak fitting. (**a**) SiO_2@ZrO_2 0.04M-CaO ; (**b**) SiO_2@ZrO_2 0.06M-CaO and (**c**) SiO_2@ZrO_2 0.08M-CaO.