Electronic Supplementary Material (ESI) for Reaction Chemistry & Engineering.

Supporting information

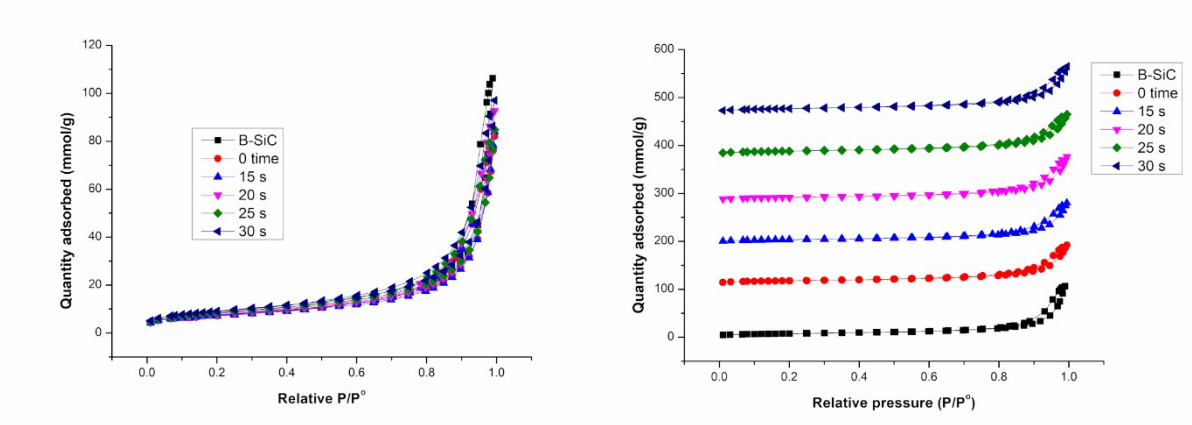

Figure S1: BET isotherms of the Fe catalysts

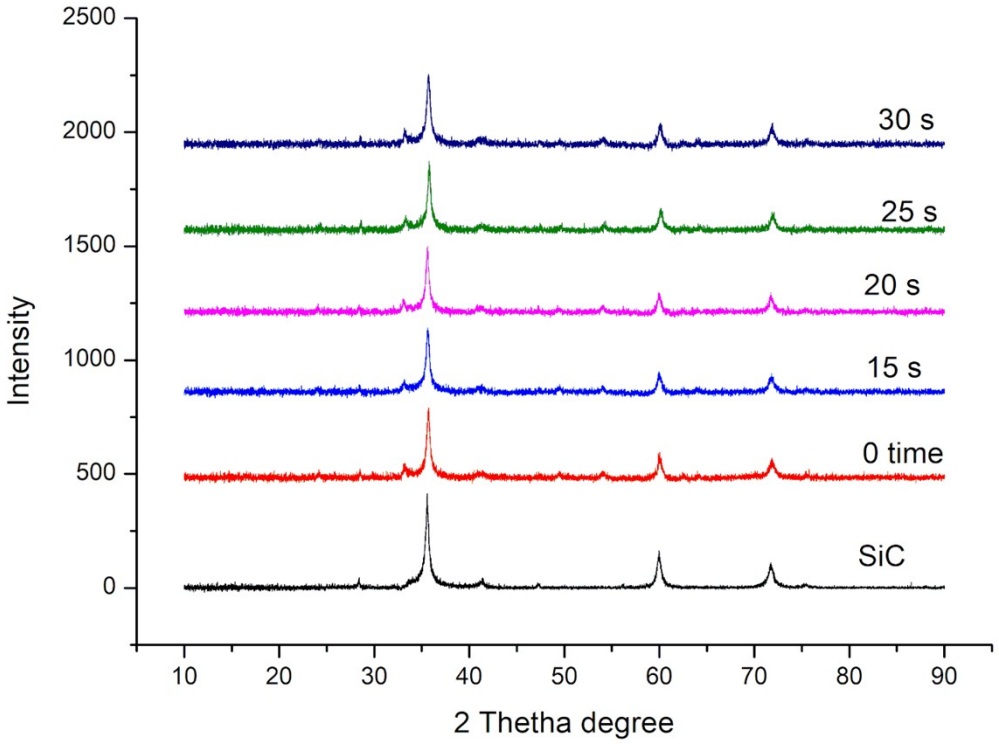

Figure S2: XRD of Fe catalysts

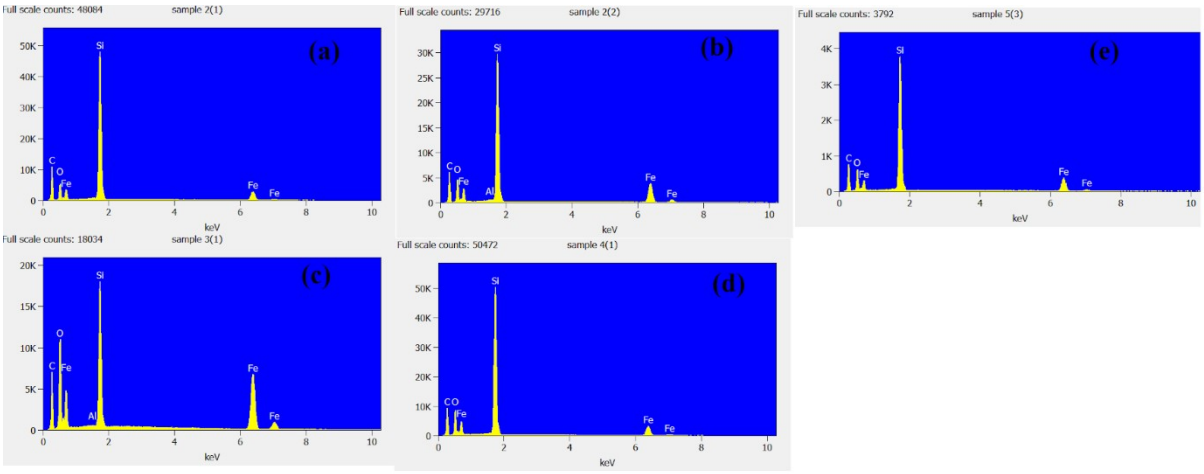

Figure S3: EDX of Fe catalysts. (a) Fe-βSiC (0 time), (b) Fe-βSiC (15 s MIR), (c) Fe-βSiC (20 s MIR), (d) Fe-βSiC (25 s MIR), (e) Fe-βSiC (30 s MIR).

The CO conversions, CO reactions rates and products selectivities were calculated based on mass balance calculations reported by Lu and Muleya *et al*, and are as follow:

$\%M\ (gas) =$ (Agas/Acal) x M (Cal) (1)

% M (gas) = Molar percentage of a gas analyzed.

Agas = integrated area of the GC (Gas chromatography) peak corresponding to the gas analyzed.

Acal = integrated area of the GC peak corresponding to the gas of interest in the calibration gas mixture.

M (Cal) = Molar percentage of the gas of interest in the calibration gas mixture.

Regarding compounds that are not present in the calibration mixture, calibration of reference compound and response factors were used. The following equation was used:

$\%M\ (gas) =$ (Agas/ARcal) x % α x RF (2)

% α = Molar percentage of the reference compound in the calibration gas mixture.

ARcal = integrated area from the GC peak of the reference compound in the calibration gas mixture.

RF = Response factor of the gas analyzed with respect to the reference compound.

C_2H_4 was used as a reference for olefins while C_2H_6 was a reference for paraffins. The response factors of hydrocarbons are presented in Table 1 below.

Table 1: Response factors of hydrocarbons products (C2 as reference).

Carbon number	Olefin	Paraffin
2	1	1
3	0.7	0.74
4	0.55	0.55
5	0.47	0.47
6	0.4	0.4
7	0.35	0.35
8	0.32	0.32
9	0.28	0.28
10	0.24	0.24
11	0.21	0.21

12	0.19	0.19
13	0.18	0.18
14	0.17	0.17
15	0.15	0.15

In our Fischer-Tropsch (FT) experiment, Nitrogen (N_2) was used as an internal standard. The N_2 balance in the reactor was then expressed by the equation 3 below:

$F_{in} \times XN_{2in} = F_{out} \times XN_{2out}$ (3)

F_{in} = Total molar flow rate (mol/min) of the reactor feed.

XN_{2in} = Molar fraction of the N_2 in the reactor feed.

F_{out} = Total molar flow rate (mol/min) of the reactor outlet gas stream.

XN_{2out} = Molar fraction of the N_2 in the reactor outlet gas.

The rate of CO conversion was calculated by the equation 4 as follow:

$$-r_{CO} = \frac{FCO,in - FCO,out}{mcat} \quad (4)$$

$-r_{CO}$ = rate of CO conversion (mol/min/gcat).

$F_{CO,\,in}$ = Molar flow rate [mol/min] of CO in the reactor feed.

$F_{CO,\,out}$ = Molar flow rate [mol/min] of CO in the reactor outlet gas.

mcat = mass of the catalyst.

The CO conversion was calculated by the equation 5 below:

$$\%CO_{conv} = \frac{[X_{CO,in} - X_{CO,out} \times \left(\frac{X_{N_2,in}}{X_{N_2,out}}\right)] \times 100}{X_{CO,in}} \quad (5)$$

$X_{CO, in}$ and $X_{CO, out}$ = Molar fraction of CO in the reactor feed and outlet gas.

$X_{N2, in}$ and $X_{N2, out}$ = Molar fraction of N_2 in the reactor feed and outlet.

The products selectivities were calculated using the equations (6) and (7) below:

$$Sel(\theta) = \frac{[nC]_\theta}{-r_{CO} \times t \times m_{cat}} \quad (6)$$

$$S_{C_{5+}} = 100\% - \sum_{n-1}^{4} S_{C_n} \quad (7)$$

$Sel(\theta) = Product\ selectivity$

$[nC]_\theta = Carbon\ number$

$S_{C_{5+}} = C5 + product\ selectivity$