

Supporting Information
for

Steel Slag as Low-Cost Catalyst for Artificial Photosynthesis: From CO₂ to Hydrogen and Methanol

Caterina Fusco,^[a] Michele Casiello,^[b] Pasquale Pisani,^[b] Antonio Monopoli,^[b] Werner Oberhauser,^[c]
Rosella Attrotto,^[d] Angelo Nacci,^[a,b] Lucia D'Accolti^{*,[a,b]}

-
- [a] Dr C.Fusco. CNR-ICCOM-SS Bari via orabona 4 70125 Bari Italy
[b] Dr. M. Casiello, P. Pisani, A. Monopoli, Prof. A. Nacci, Prof. L. D'Accolti
Chemistry Department -University of Bari, via orabona 4, 70125 Bari Italy
[c] Dr. W. Oberhuser CNR-ICCOM Sesto Fiorentino Firenze Italy
[d] Dr. R. Attrotto Acciaierie d'Italia S.p.A.
Research and Development Department
SS Appia km 648 - 74123 Taranto, Ital

(10 pages, including this cover)

Table of Contents

PXRD spectrum of the slag acquired at room temperature.....	p.S2
FTIR-ATR spectrum of Pd-slag virgin.....	p. S3
HRC UV-VIS lamp 300W (Sanolux) and Xe-Halogen lamp 400W (Radium) spectra.....	p.S4
Calibration curve for determination of HCOOH.....	p. S5
Calibration curve for determination of CH ₃ OH [10 ⁻⁵ -10 ⁻⁴ M]	p. S6
Calibration curve for determination of CH ₃ OH [10 ⁻³ M]	p. S7
Calibration curve for determination of H ₂	p. S8
Calibration curve for determination of CO.....	p. S9
Calibration curve for determination of CO ₂	p. S10

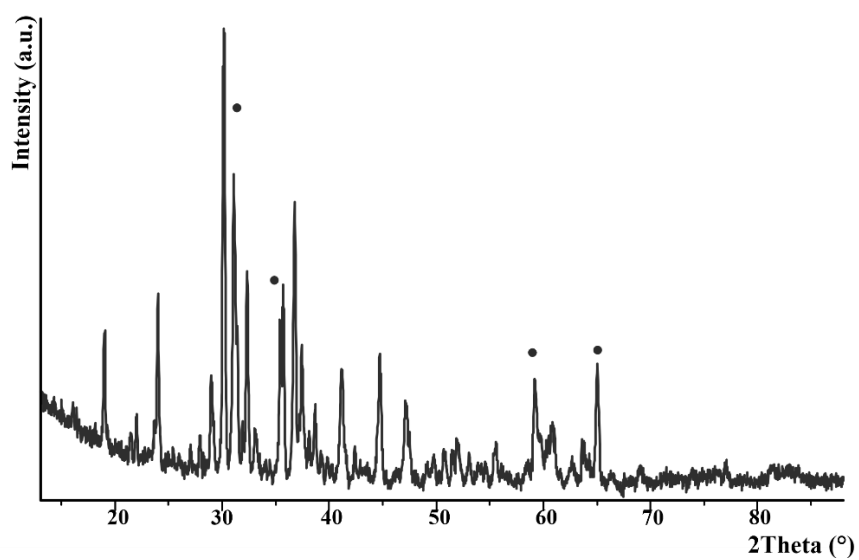


Figure S1. PXRD spectrum of the slag acquired at room temperature: The Bragg reflexes marked with a full circle belong to Fe_3O_4 .

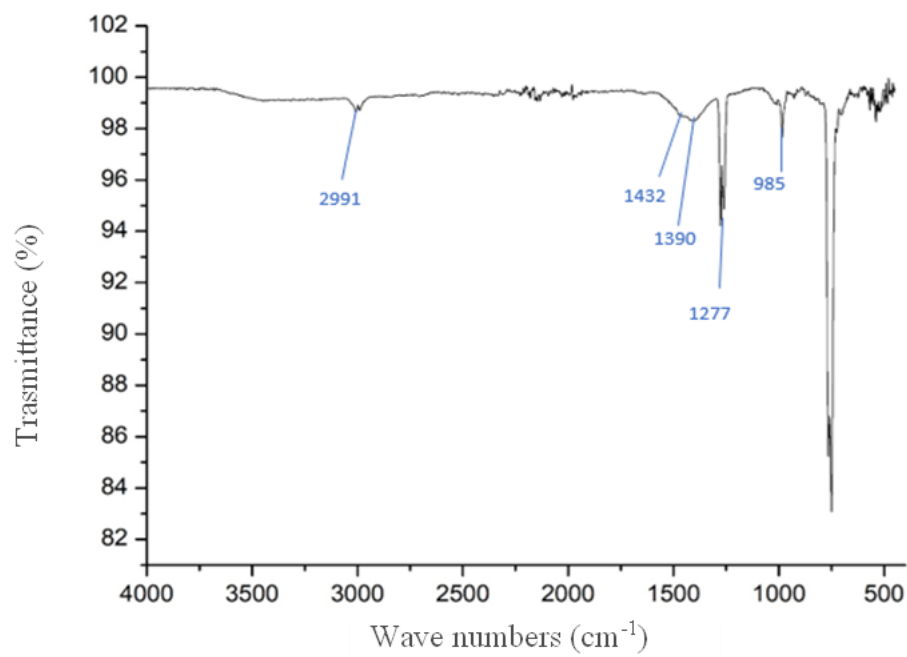


Figure S2. FTIR-ATR of Pd-slag virgin

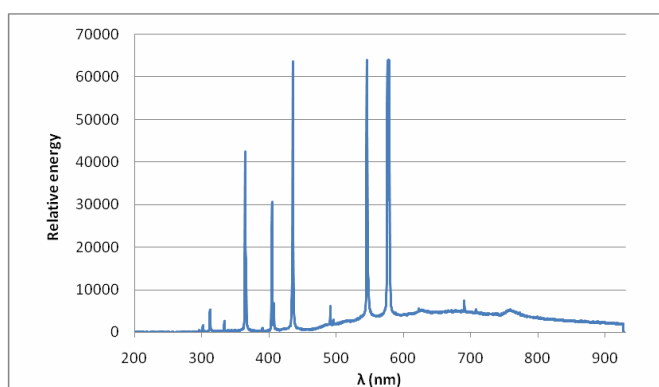
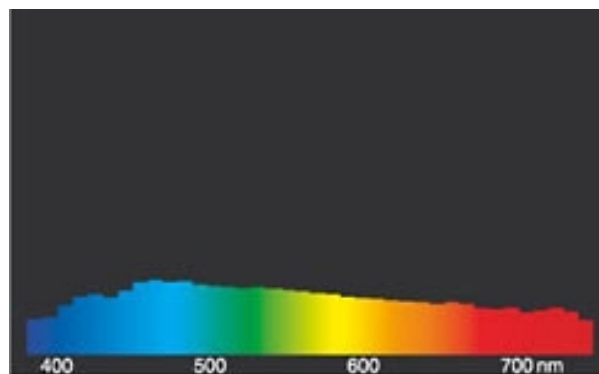


Figure S3. A HRC UV-VIS lamp 300W (Sanolux).



Xe-Halogen lamp 400W (Radium)

Calibration curve for determination of HCOOH

To evaluate yields of HCOOH, a calibration curve was prepared by means of 5 standard solutions of HCOOH into water at different concentration; subsequently the solutions were analysed through gas-chromatograph (Tracera) with a HP-INNOWAX column and with He as a carrier gas; the detector was BID. The experimental parameters are:

HP-INNOWAX column

- Length: 30 m
- I.D.= 0.250 mm
- Film: 0.25 μ m
- T. Injector: 200°C

GC-BID:

RATE	T(°C)	HOLD TIME (min)
-	40	5
15	220	5
40	240	10

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig. S1):

	Concentration (M)	Average area	Standard deviation
1.	0.00020	2270363	102620
2.	0.00040	2435003	37986
3.	0.00081	3029592	93917
4.	0.00161	4384564	144690
5.	0.00242	5861831	93789

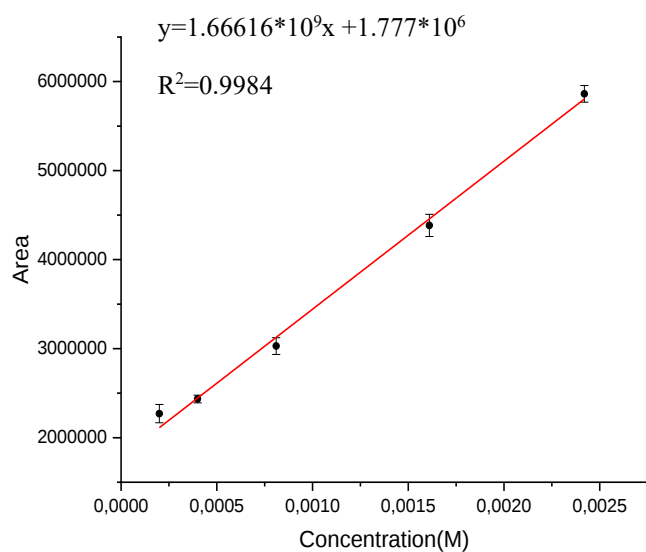


Figure S4. Calibration curve for evaluating yields of formic acid

Calibration curve for determination of CH₃OH [10⁻⁵-10⁻⁴M]

To evaluate yields of CH₃OH, a calibration curve was prepared by means of 5 standard solutions of CH₃OH into water at different concentration; subsequently the solutions were analysed through gas-chromatograph (Tracera) with a HP-INNOWAX column. The experimental parameters are:

HP-INNOWAX column

- Length: 30 m
- I.D.= 0.250 mm
- Film: 0.25 µm
- T. Injector: 200°C

GC-BID:

RATE	T(°C)	HOLD TIME (min)
-	40	5
15	220	5
40	240	10

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig.S2):

	Concentration (M)	Average area	Standard deviation
1.	3*10 ⁻⁵	1706	402
2.	4*10 ⁻⁵	5216	399
3.	5*10 ⁻⁵	31116	996
4.	6.6*10 ⁻⁵	60618	1618
5.	10 ⁻⁴	170662	1470

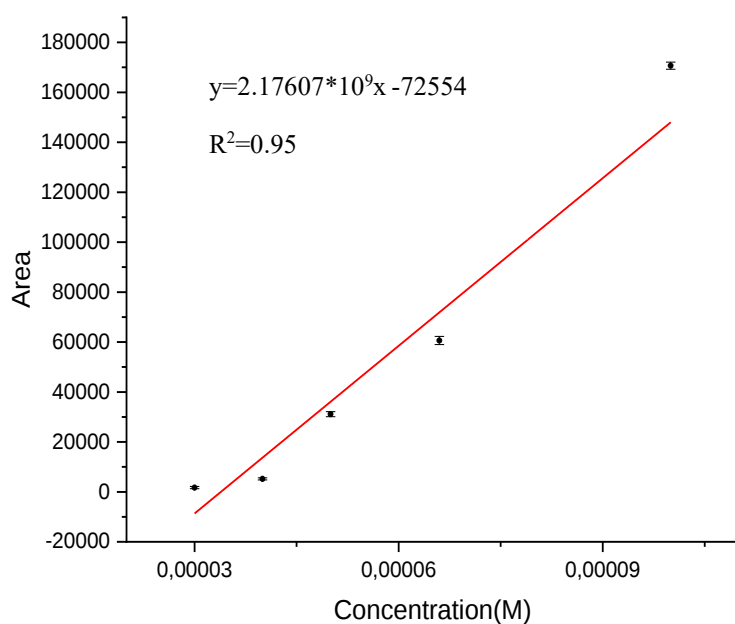


Figure S5. Calibration curve for evaluating yields of CH₃OH

Calibration curve for determination of CH₃OH [10⁻³M]

To evaluate yields of CH₃OH, a calibration curve was prepared by means of 5 standard solutions of CH₃OH into water at different concentration; subsequently the solutions were analysed through gas-chromatograph (Tracera) with a HP-INNOWAX column. The experimental parameters are:

HP-INNOWAX column

- Length: 30 m
- I.D.= 0.250 mm
- Film: 0.25 µm
- T. Injector: 200°C

GC-BID:

RATE	T(°C)	HOLD TIME (min)
-	40	5
15	220	5
40	240	10

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig.S3):

	Concentration (M)	Average area	Standard deviation
1.	0.00125	833429	43338
2.	0.00249	930519	21402
3.	0.0049	1116965	69252
4.	0.0065	1295002	16835
5.	0.0098	1534492	35293

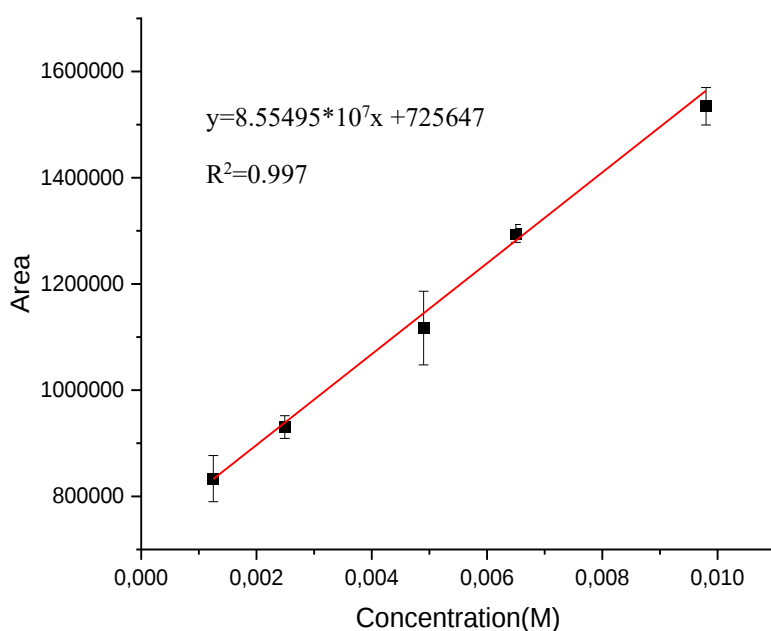


Figure S6. Calibration curve for evaluating yields of CH₃OH

Calibration curve for determination of H₂

To evaluate yields of H₂, a calibration curve was prepared by means of 5 standards of H₂ and air at different concentration directly in gas syringe(1mL); subsequently standards were analysed through gas-chromatograph (Tracera) with a RESTEK column and with He as a carrier gas. The experimental parameters are:

RESTEK column

- Length: 2 m
- I.D.= 0.53 mm
- T. Injector: 150°C

GC-BID:

Rate	T(°C)	Hold time (min)
-	35	2.5
20	250	10
15	270	5.42

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig. S4):

	Concentration %	Average area	Standard deviation
1.	4	1185313	66377
2.	5	1258154	78005
3.	10	1684871	53916
4.	20	2708870	75848
5.	50	4344378	99920

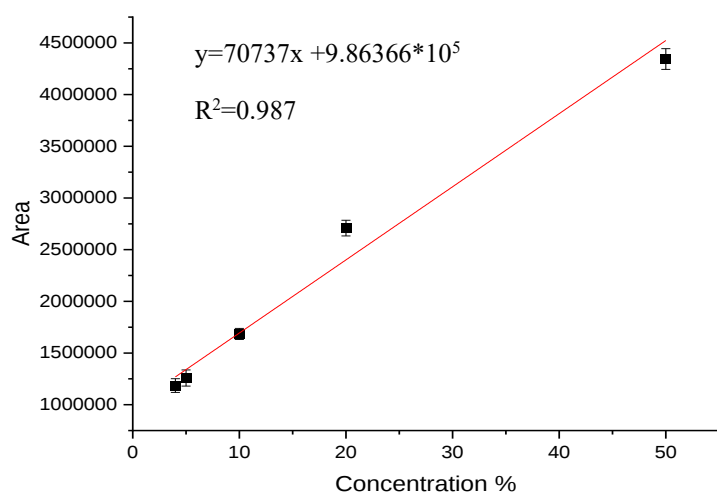


Figure S7. Calibration curve for evaluating yields of H₂

Calibration curve for determination of CO

To evaluate yields of CO, a calibration curve was prepared by means of 7 standards of CO and air at different concentration directly in gas syringe(1mL); subsequently standards were analysed through gas-chromatograph (Tracera) with a RESTEK column and with He as a carrier gas. The experimental parameters are:

RESTEK column

- Length: 2 m
- I.D.= 0.53 mm
- T. Injector: 150°C
-

GC-BID:

Rate	T(°C)	Hold time (min)
-	35	2.5
20	250	10
15	270	5.42

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig. S5):

	Concentration %	Average area	Standard deviation
1.	4	5717628	285881
2.	5	6105925	360249
3.	10	10520862	347188
4.	20	15700809	455323
5.	30	17358855	563171
6.	40	18028640	272232
7.	50	20222868	469170

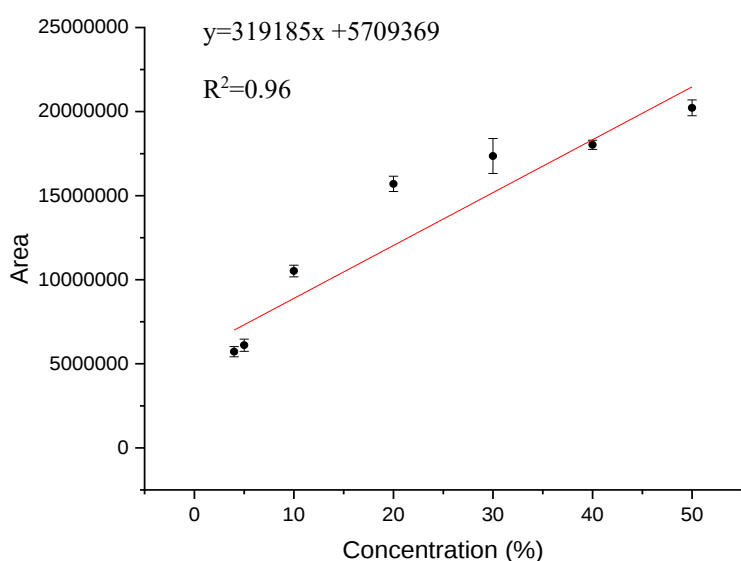


Figure S8. Calibration curve for evaluating yields of CO

Calibration curve for determination of CO₂

To evaluate yields of CO₂, a calibration curve was prepared by means of 4 standards of CO₂ and air at different concentration directly in gas syringe(1mL); subsequently standards were analysed through gas-chromatograph (Tracera) with a RESTEK column and with He as a carrier gas. The experimental parameters are:

RESTEK column

- Length: 2 m
- I.D.= 0.53 mm
- T. Injector: 150°C
-

GC-BID:

Rate	T(°C)	Hold time (min)
-	35	2.5
20	250	10
15	270	5.42

GC-BID areas were collected (for each solution by means of three replicates and the average area is reported in Fig. S6):

	Concentration %	Average area	Standard deviation
1.	1	3321984	428121
2.	10	13774308	1603518
3.	20	19857565	1112034
4.	30	24252599	1964460
5.	40	26915206	942032
6.	50	30860975	2129407

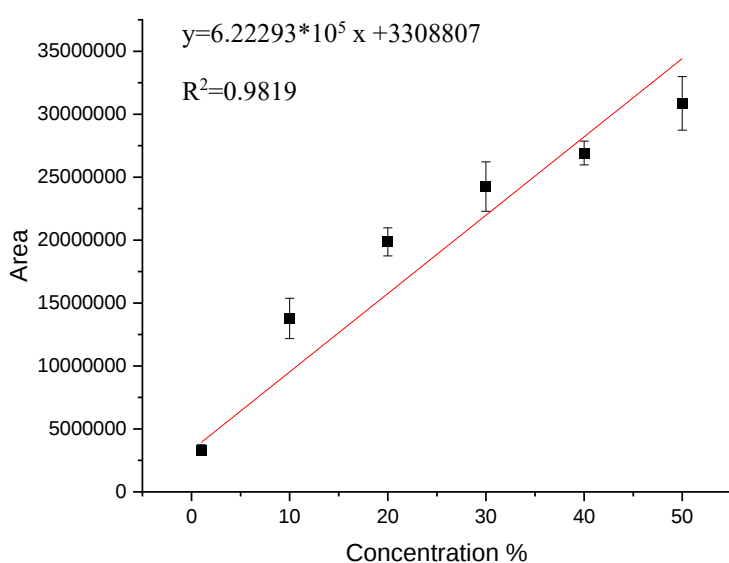


Figure S9. Calibration curve for evaluating yields of CO₂