

Figure S1: A schematic representation of primary mill scale produced in different regions around the world in 2021.

The mill scale volumes were computed as being 2% of the total steel produced in different regions of the world [1].

1. Major Steel-Producing Countries 2021 and 2020 Million Tonnes, Crude Steel Production.

Available online: <https://worldsteel.org/steel-topics/statistics/world-steel-in-figures-2022/>

(accessed on 25 September 2023).

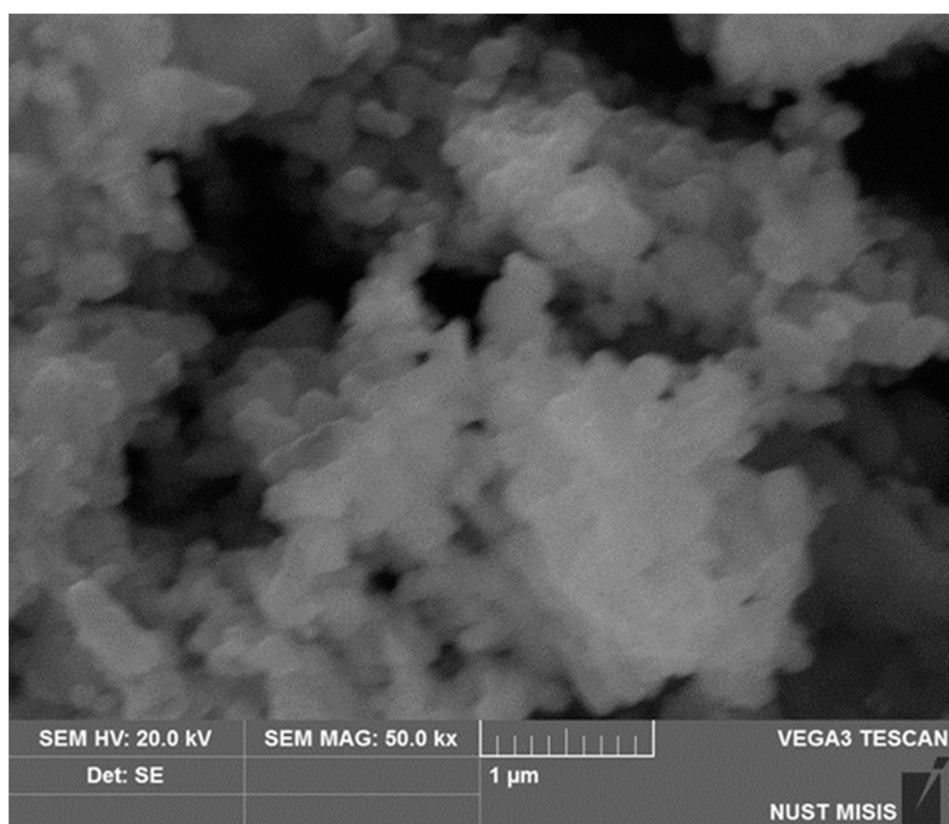


Figure S2. SEM image of the red mill scale used in this investigation.

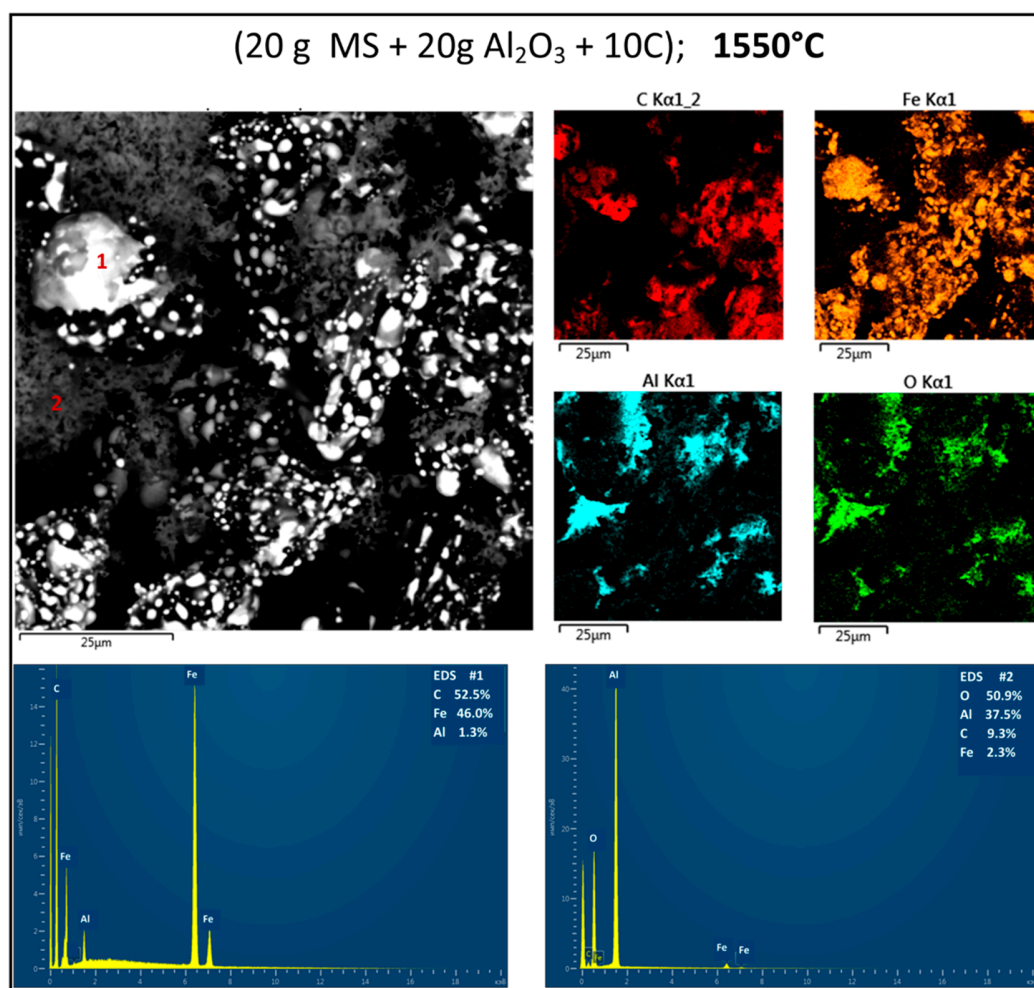


Figure S3. SEM/EDS/elemental mapping results for the (20g red MS+20g Al₂O₃+10g C) system heat treated at 1550°C.

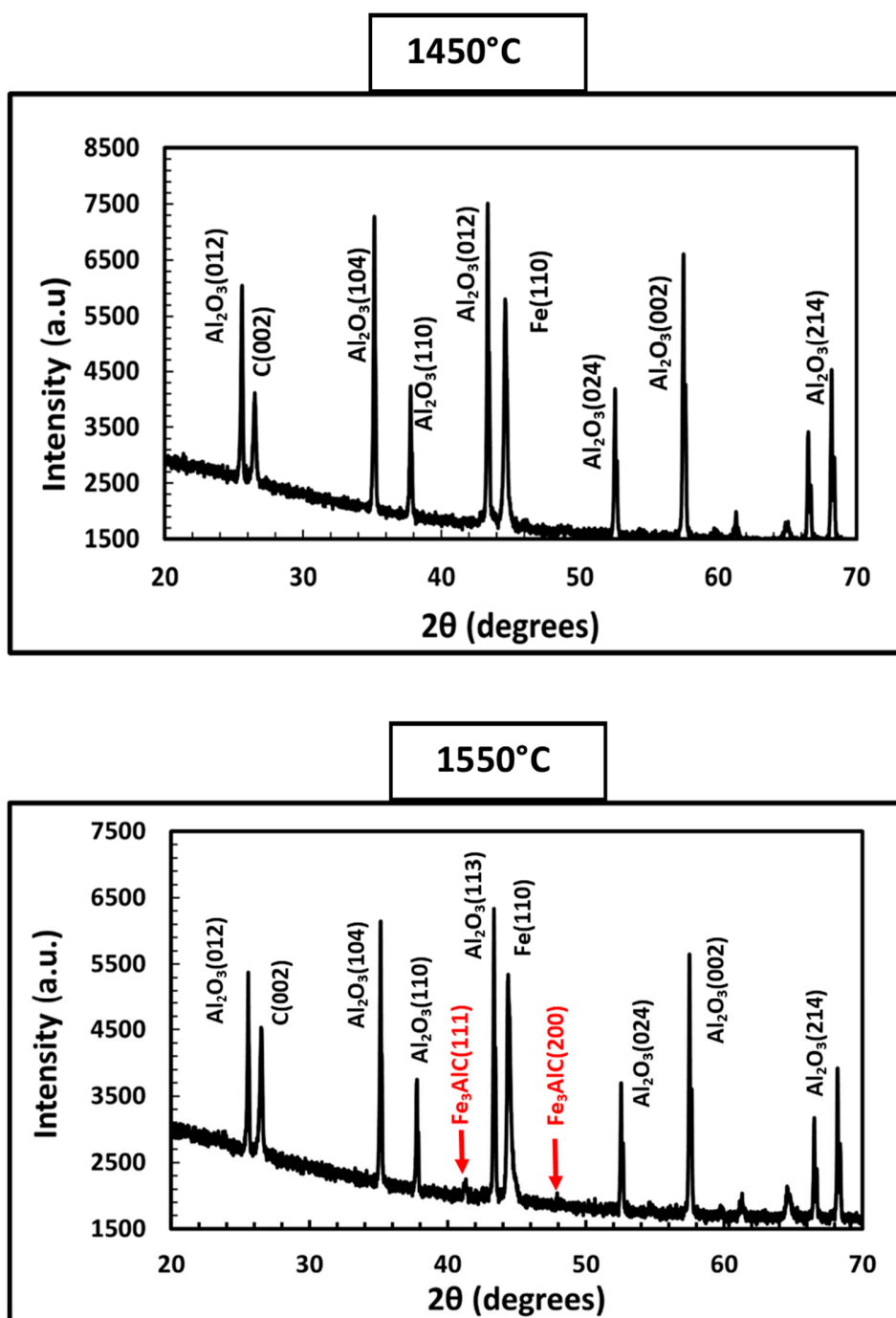


Figure S4. X-ray diffraction patterns for the (20g red MS+20g Al_2O_3 +10g C) system after heat treatments at 1450°C and 1550°C

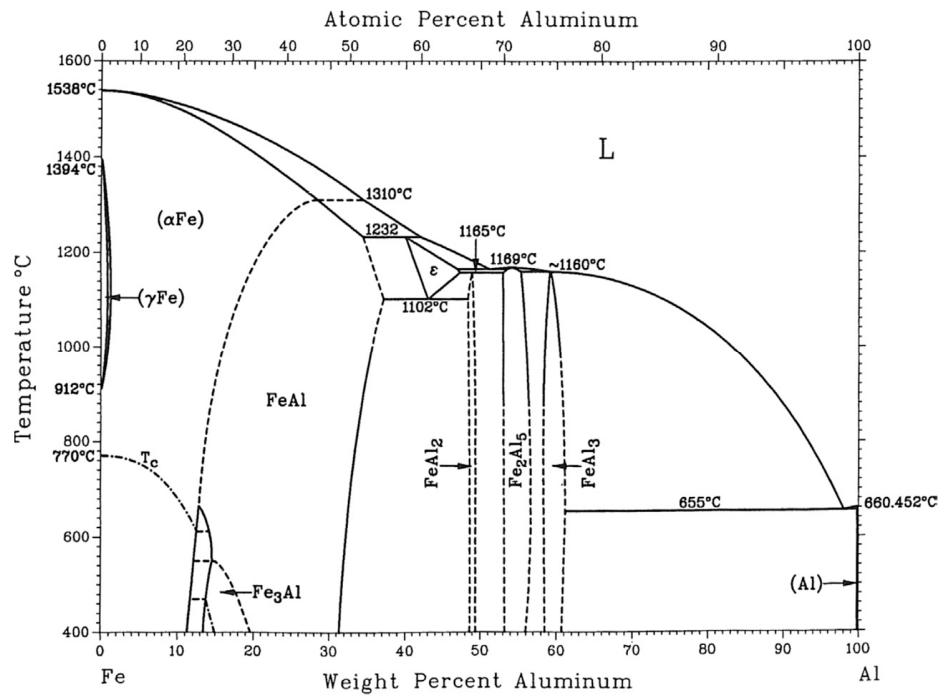


Figure S5. Binary Fe-Al phase diagram [1]

[1] Murray, J.L. Fe-Al binary phase diagram. In Alloy Phase Diagrams; Baker, H., Ed.; ASM International: Materials Park, OH, USA, 1992; Volume 54.

Table S1. Composition of red MS as determined by XRF data on several particulates.

Spectrum (wt.%)	1	2	3	4	5
Fe	65.9	73	68.2	74.2	72.3
O	33.6	26.6	31.4	24.8	27.4
Cl	0.5	0.4	0.4	0.7	0.3
Mn	-	-	-	0.3	-

Table S2. BET surface area data on red MS.

Quantachrome NovaWin2 - Data Acquisition and Reduction
for NOVA instruments
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version 9.0

Analysis

Operator: MISIS
Sample ID: Minhhh
Sample Desc: Minhhh
Sample weight: 0.2448 g
Outgas Time: 3.0 hrs
Analysis gas: Nitrogen
Press. Tolerance: 0.200/0.200 (ads/des)
Analysis Time: 23.8 min
Cell ID: 67

Date: 2015/03/12

Filename: D:\NOVA\Physisorb\2016\Nova\Minhhh.qps
Comment: Minhhh
Sample Volume: 0.08179 cc
Outgas Temp: 300.0 C
Bath Temp: 77.3 K
Equil time: 60/60 sec (ads/des)
End of run: 2015/03/12 2:48:14

Report

Operator: D:\NOVA\Physisorb\2016\Nova\Minhhh.qps

Date: 12/1/2023

Equil timeout: 240/240 sec (ads/des)
Instrument: Nova Station A

Multi-Point BET

Data Reduction Parameters Data

<u>Adsorbate</u>	Nitrogen	Temperature	77.350 K	
	Molec. Wt.: 28.013 g	Cross Section:	16.200 Å ²	Liquid Density: 0.808 g/cc

Multi-Point BET Data

Relative Pressure [P/P ₀]	Volume @ STP [cc/g]	1 / [W((P ₀ /P) - 1)]	Relative Pressure [P/P ₀]	Volume @ STP [cc/g]	1 / [W((P ₀ /P) - 1)]
4.56180e-02	0.9260	4.1301e+01	1.99628e-01	1.8053	1.1054e+02
9.78150e-02	1.2370	7.0127e+01	2.50003e-01	2.0855	1.2789e+02
1.48984e-01	1.5306	9.1516e+01	3.00130e-01	2.3808	1.4412e+02

BET summary

Slope = 397.185
Intercept = 2.859e+01
Correlation coefficient, r = 0.995053
C constant = 14.891
Surface Area = 8.179 m²/g