Supporting Information

Unlocking the value of food waste: sustainable production of ethylene glycol over low-cost Ni-W catalysts supported on glucose-derived carbons

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1. Characterization of substrates

1.1. Textural properties

The SEM results of the food wastes before and after ball-milling are presented in Figure S.1 and Figure S.2, respectively.

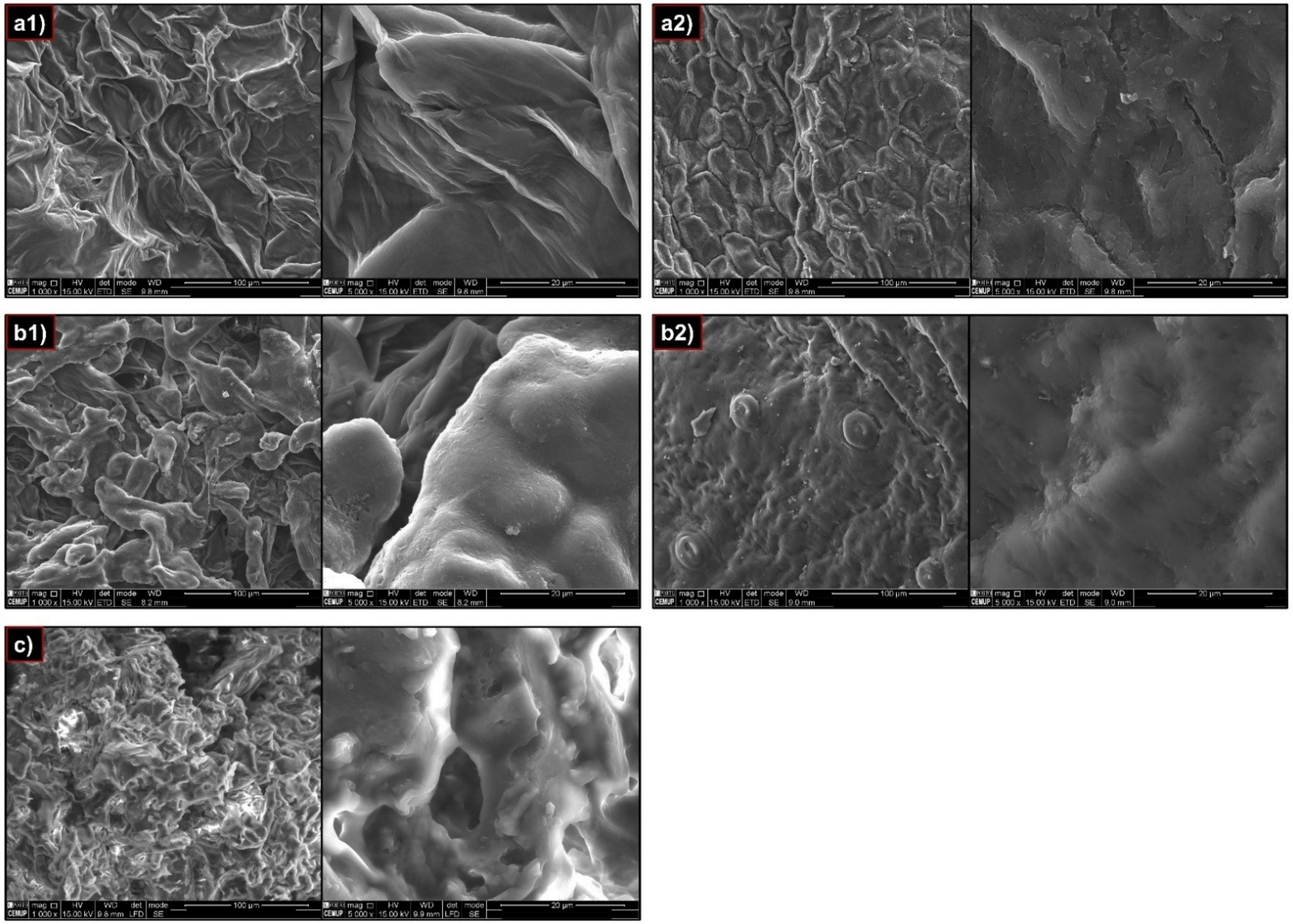

Figure S.1 – SEM images of the untreated food wastes (×1000 and ×5000 magnifications): a) banana peel, b) orange peel and c) spent coffee grounds. In images a) and b), the numbers 1 and 2 correspond to the inner and outer sides of the fruit peel, respectively.

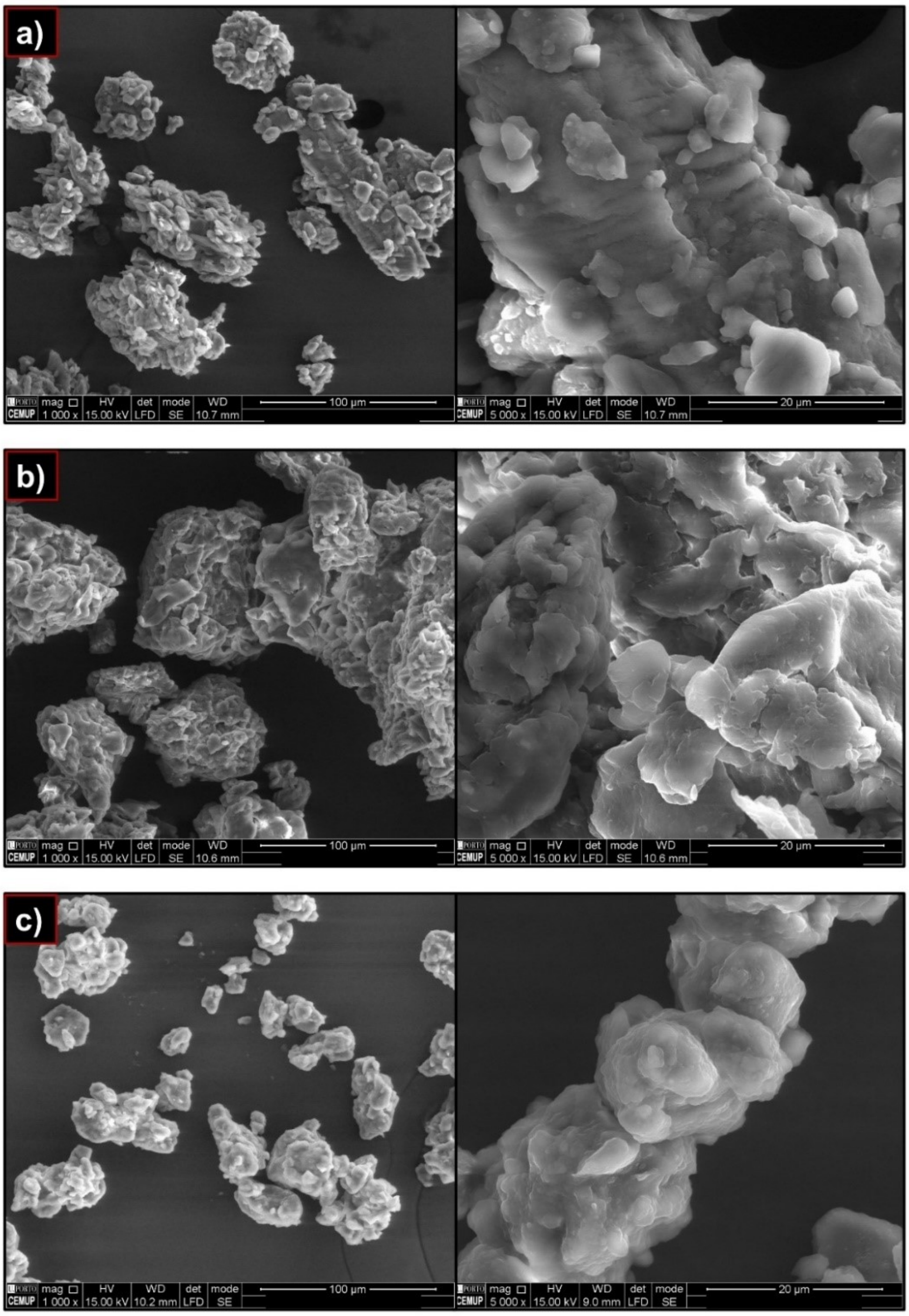

Figure S.2 – SEM images of the ball-milled wastes (×1000 and ×5000 magnifications): a) banana peel, b) orange peel and c) spent coffee grounds.

2. Characterization of catalysts

2.1. Textural properties

The N_2 adsorption-desorption isotherms of the synthesized Ni-W catalysts supported on glucose-derived carbons are shown in Figure S.3.

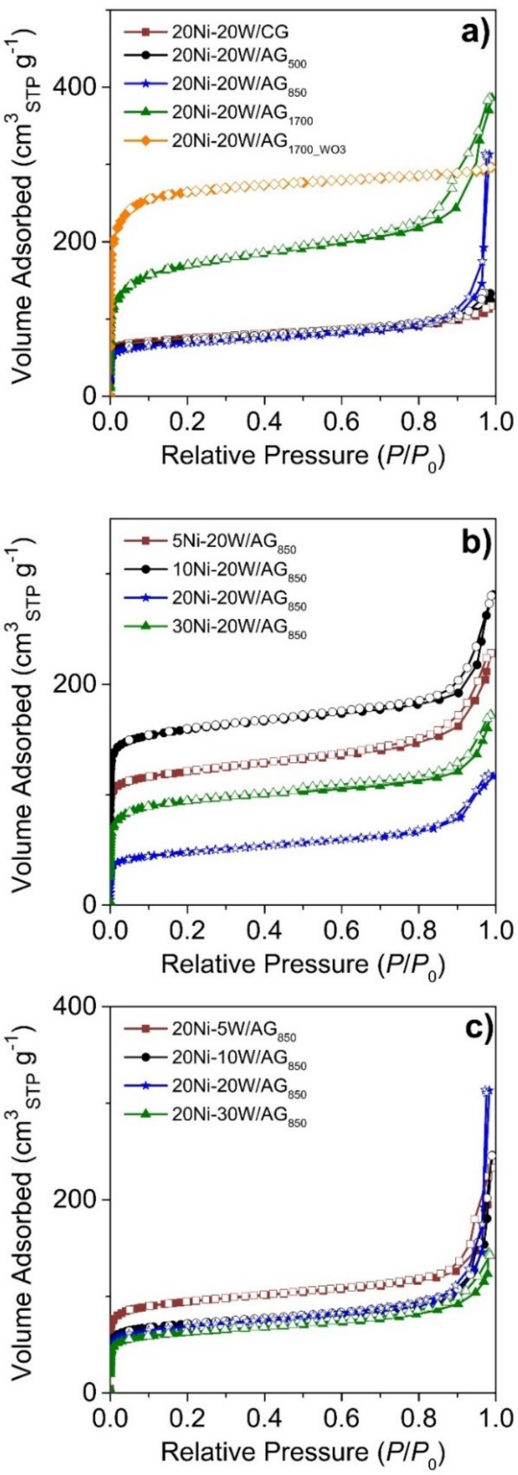

Figure S.3 – N_2 adsorption-desorption isotherms of the Ni-W catalysts.

2.2. Microscopy

The SEM images and EDS results of the synthesized Ni-W catalysts supported on glucose-derived carbons are presented in Figure S.4 and Figure S.5, respectively, while the elemental mapping is displayed in Figure S.6.

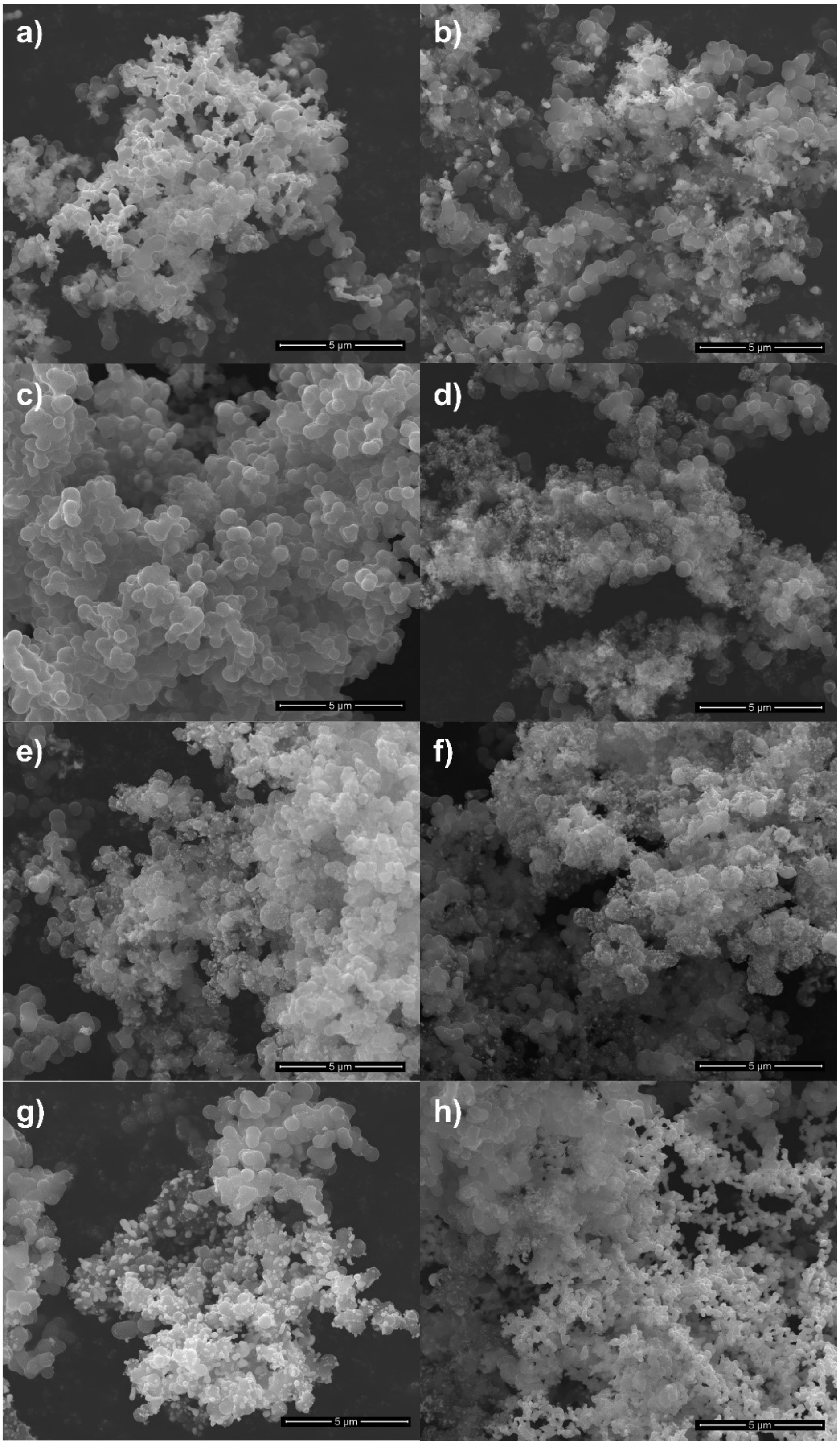

Figure S.4 – SEM images of a) 20Ni-20W/CG, b) 20Ni-20W/AG$_{500}$, c) 20Ni-20W/AG$_{1700}$, d) 5Ni-20W/AG$_{850}$, e) 10Ni-20W/AG$_{850}$, f) 20Ni-20W/AG$_{850}$, g) 30Ni-20W/AG$_{850}$ and h) 20Ni-10W/AG$_{850}$,

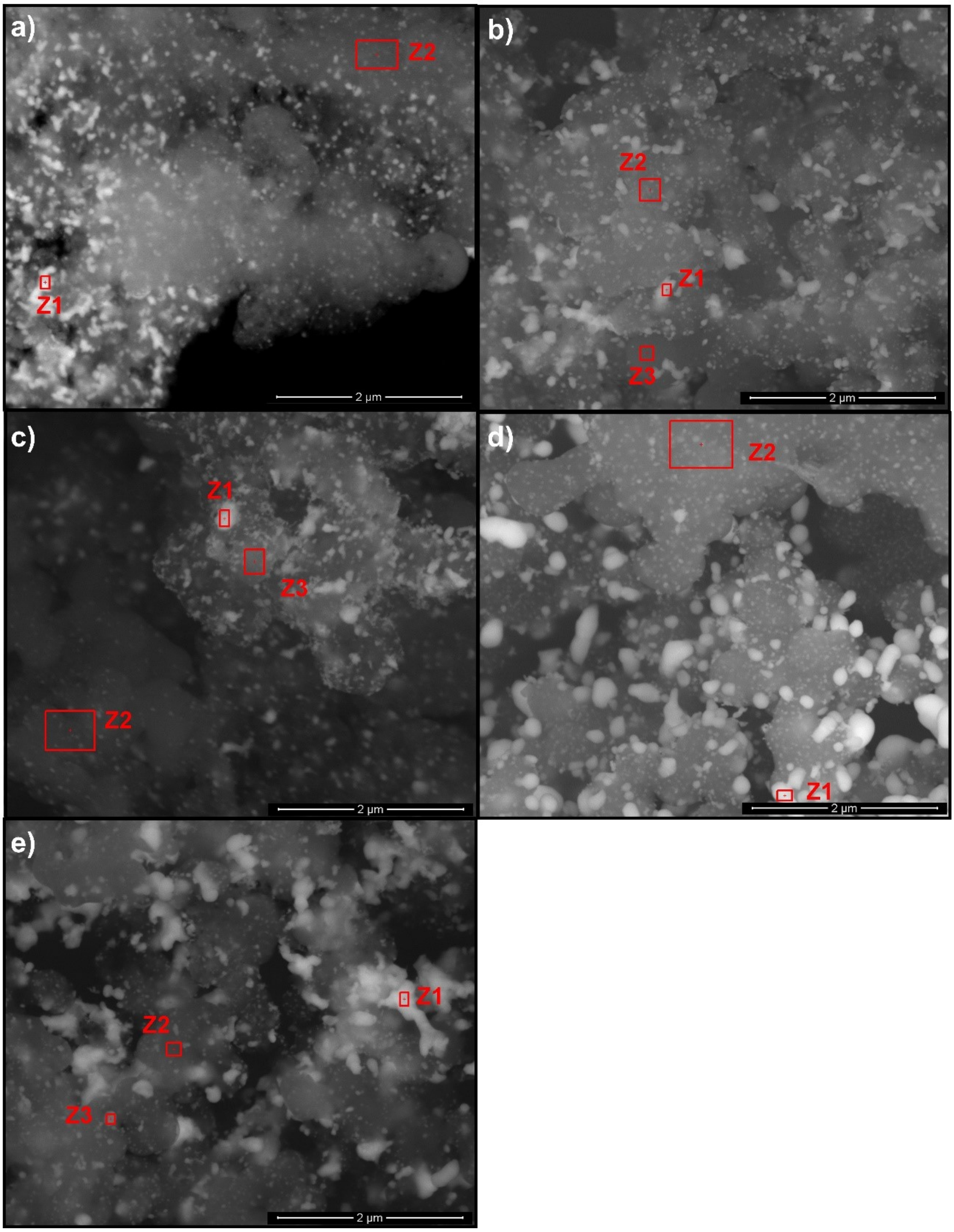

Figure S.5 – BSED micrographs of a) 5Ni-20W/AG$_{850}$, b) 10Ni-20W/AG$_{850}$, c) 20Ni-20W/AG$_{850}$, d) 30Ni-20W/AG$_{850}$ and e) 20Ni-10W/AG$_{850}$.

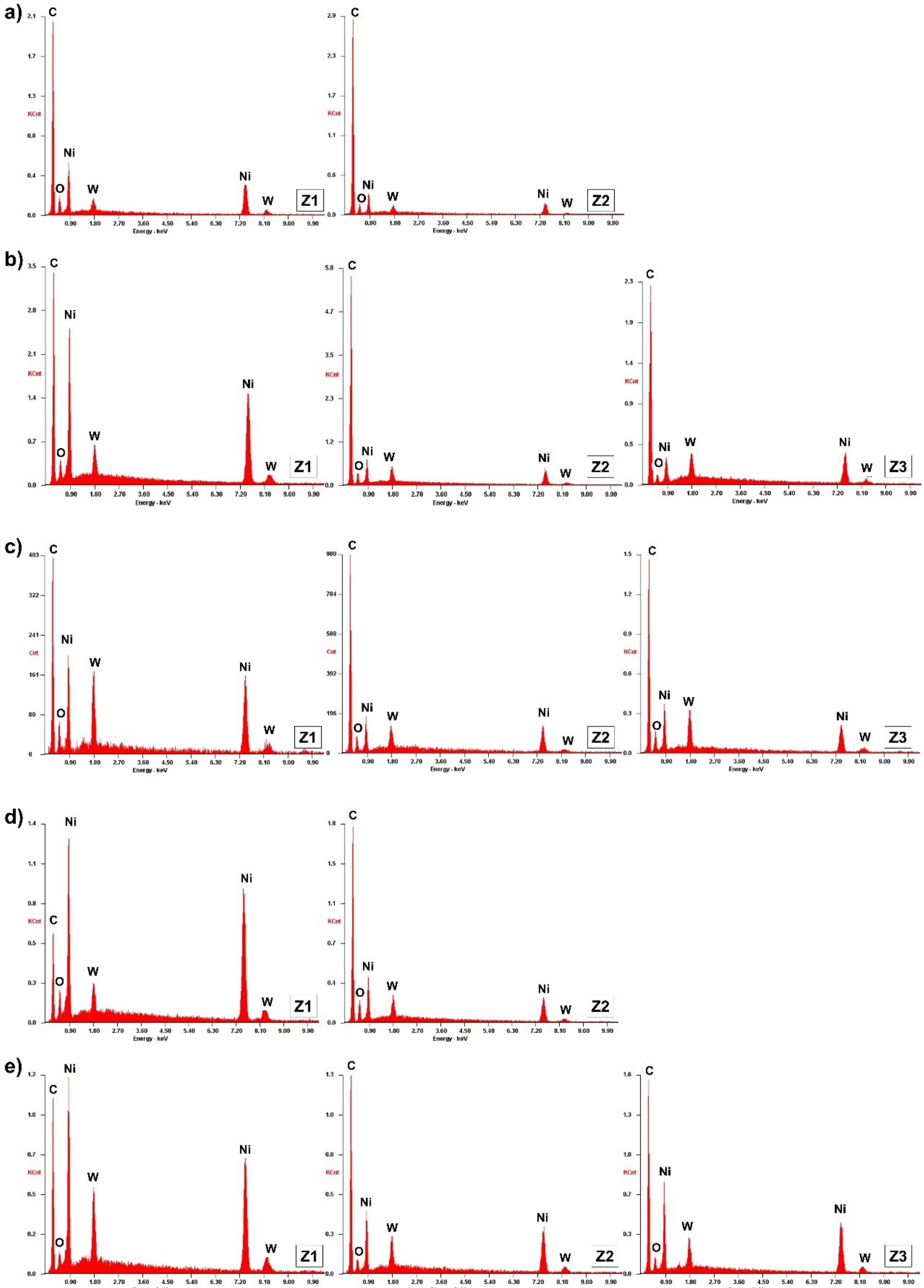

Figure S.6 – EDS analysis of a) 5Ni-20W/AG$_{850}$, b) 10Ni-20W/AG$_{850}$, c) 20Ni-20W/AG$_{850}$, d) 30Ni-20W/AG$_{850}$ and e) 20Ni-10W/AG$_{850}$. [The respective zones are displayed in Figure S.5]

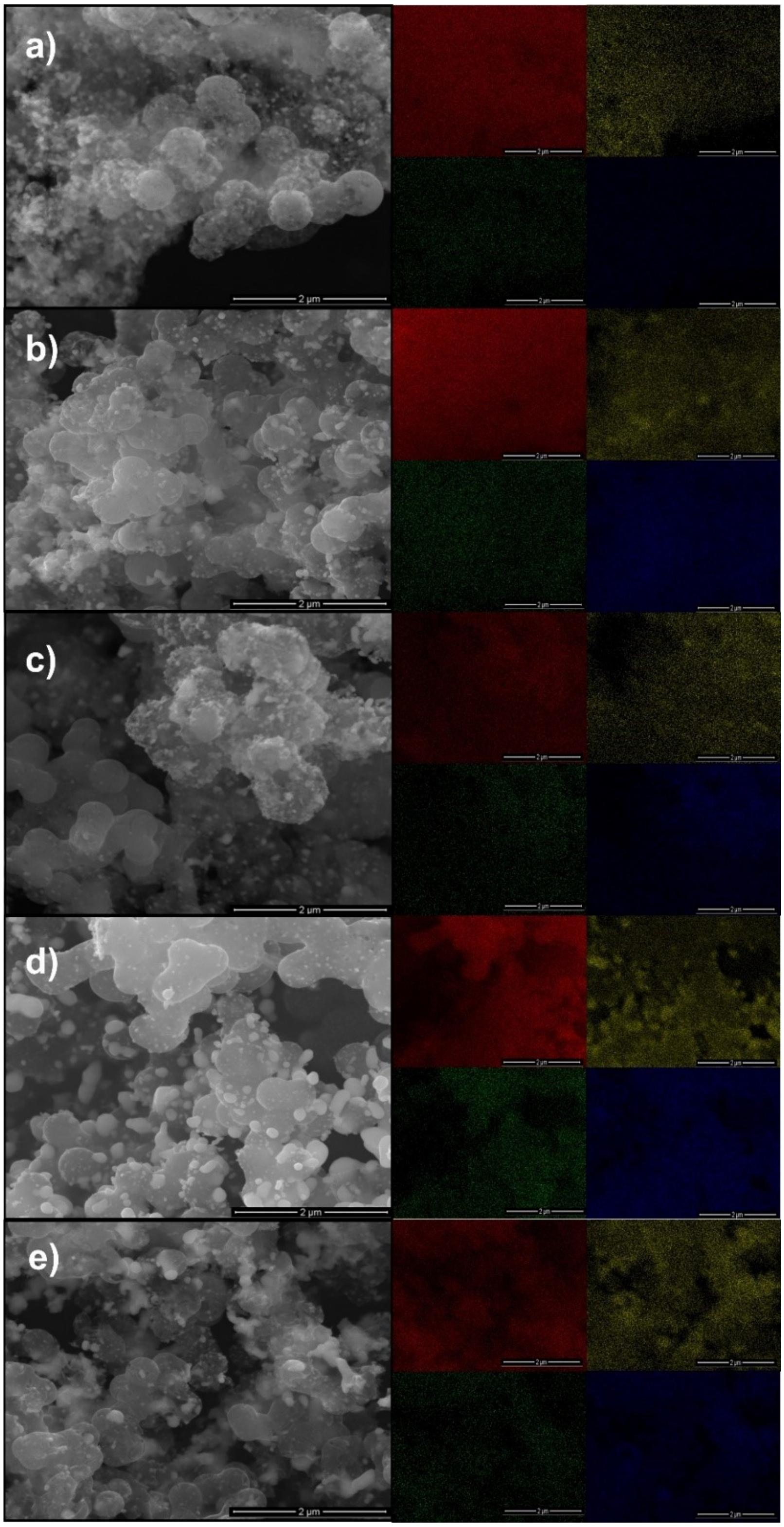

Figure S.7 – Elemental mapping of a) 5Ni-20W/AG$_{850}$, b) 10Ni-20W/AG$_{850}$, c) 20Ni-20W/AG$_{850}$, d) 30Ni-20W/AG$_{850}$ and e) 20Ni-10W/AG$_{850}$. C (red), O (green), Ni (yellow) and W (blue) are represented in the elemental maps given.

3. Catalytic tests

Table S.1 displays the results obtained in four additional tests: 1) using the support without the addition of the metal phase (AG_{850}), 2) using a monometallic Ni catalyst, 3) using a monometallic W catalyst, and 4) using a physical mixture of two monometallic Ni and W catalysts.

Table S.1 – Catalytic results of cellulose conversion and yield of products[a].

Entry	Catalyst	X (%)	Yields ± 1.7 [b] (%)									
			EG	PG	SOR	THR	ERY	GLY	FA	DHA	HA	Others
1	AG_{850}	93	7.8	2.5	1.5	0.0	0.0	3.9	1.5	0.0	0.0	75.8
2	$20Ni/AG_{850}$	100	12.5	3.3	32.9	1.1	2.4	5.4	0.0	7.2	2.3	32.9
3	$10W/AG_{850}$	100	35.1	0.0	1.6	0.0	0.0	8.2	0.0	0.1	12.4	42.6
4	$20Ni/AG_{850}$ + $10W/AG_{850}$ [c]	100	47.2	2.3	7.8	0.9	1.2	4.0	0.5	0.1	5.5	30.5

[a] Reaction conditions: 750 mg ball-milled cellulose, 300 mg catalyst, 300 mL H_2O, 205 ºC, 50 bar H_2, 300 rpm, 5 h.

[b] EG: ethylene glycol; PG: propylene glycol; SOR: sorbitol; THR: threitol; ERY: erythritol; GLY: glycerol; FA: formic acid; DHA: dihydroxyacetone; HA: hydroxyacetone.

[c] 300 mg of each catalyst.

Figure S.8 shows the results obtained for reusability tests of 20Ni-10W/AG_{850}.

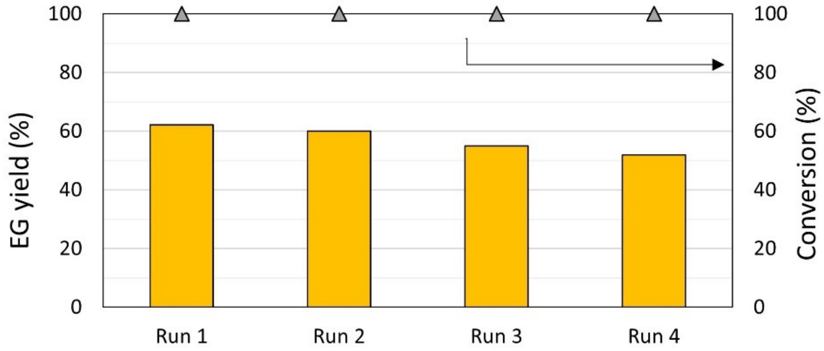

Figure S.8 – Reusability tests of 20Ni-10W/AG_{850}. Reaction conditions: 750 mg ball-milled cellulose, 300 mg 20Ni-10W/AG_{850}, 300 mL H_2O, 205 ºC, 50 bar H_2, 300 rpm, 5 h.