# Supplementary Information

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## Title: **Continuous flow hydrogenations using novel catalytic static mixers inside a tubular reactor**

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### Reagents:

The reagents vinyl acetate, oleic acid and cinnamaldehyde were obtained from Sigma Aldrich; the solvents ethyl acetate, ethanol and isopropanol were obtained from Merck KGaA. All reagents and solvents were used without further purification.

### Analysis procedure:

Reaction conversions were calculated from $^1$H NMR spectra, which were recorded on a Bruker AC-400 spectrometer in deuterated chloroform (from Cambridge Isotope Laboratories Inc.). The residual solvent peak at $\delta$ = 7.26 ppm was used as an internal reference. Product compositions were analysed by GC-FID and GC-MS. The GC-FID results were also used to confirm NMR conversions and to calculate GC-based yields. GC-mass spectra were obtained with a Perkin Elmer Clarus 600 GC mass spectrometer using electron impact ionization in the positive ion mode with an ionization energy of 70 eV. The gas chromatography was performed with a Perkin Elmer Elite-5MS GC column (30 m x 0.25 mm ID, 0.25 µm film thickness), with a temperature program of 40 °C for 2 minutes, then heating at 10 °C /min to 280 °C where the temperature was held for 4 minutes with a split ratio of 70, an injector temperature of 250 °C and the transfer line was set to 250 °C. Ultra high purity helium was used as the carrier gas with a flow rate of 0.7 ml/min. GC-FID analysis were performed on an Agilent 6850 Series II gas chromatograph with a split/splitless inlet and a detector temperature of 250 °C. Separation was done on a Grace BPX5 capillary column (25 m x 0.32 mm ID, 0.50 µm film thickness), with a temperature program of 40 °C for 2 minutes, then heating at 10 °C /min to 280 °C where the temperature was held for 4 minutes with a split ratio of 50 and an injector temperature of 200 °C. High purity helium was used as the carrier gas with a flow rate of 2.4 ml/min.

**Calculation of hydrogen gas flow rate inside the reactor:**

Since the mass flow controller operates on normal flow rate (flow rate under normal conditions, i.e. p = 1 atm, T = 0 °C, measured inside the mass flow controller), it is necessary to calculate the actual volumetric flow of hydrogen inside the reactor. To do so, the following equation was used:

$$\frac{\dot{V}_{g,r} p_r}{T_r Z_r} = \frac{\dot{V}_{g,N} p_N}{T_N Z_N} \quad \text{(S1)}$$

Here $\dot{V}_{g,r}$, $p_r$, $T_r$, and $Z_r$ are respectively the volumetric gas flow rate, pressure, temperature and compressibility factor of the hydrogen gas at the conditions inside the reactor, while $\dot{V}_{g,N}$, $p_N$, $T_N$, and $Z_N$ are the values for the gas under normal conditions. For this equation, it is necessary to calculate the compressibility factor of hydrogen inside the reactor. For the temperature range used in our work, it can be assumed that this factor is only a function of pressure, not of temperature. The correlation between *Z* and *p* can be established by plotting the compressibility factor at 140 °C against pressures between 5 and 25 bar. Using equation S1; this gives the following expression of $\dot{V}_{g,r}$ with a $R^2$ value of 0.9999:

$$\dot{V}_{g,N} = \dot{V}_{g,r} \frac{p_r T_N Z_N}{T_r p_N e^{0.0005 * p_r}} \quad \text{(S2)}$$

The gas to liquid ratio can then be defined as:

$$\frac{G}{L} = \frac{\dot{V}_{g,r}}{\dot{V}_L} = \frac{\dot{V}_{g,N}}{\dot{V}_{tot} * A - \dot{V}_{g,N}} \quad \text{(S3)}$$

$where\ A = \ ,\ \dot{V}_L\ is\ the\ liquid\ flow\ rate\ and\ \ \dot{V}_{tot} = \dot{V}_L + \dot{V}_{g,r} \frac{p_r T_N Z_N}{T_r p_N e^{0.0005 * p_r}}$

**Parameters for and images of the cold spraying process:**

**Table S1**. Cold spray conditions for nickel coatings

| Mixer No | Uncoated mixer weight **[g]** | Traverse speed **[mm s⁻¹]** | $N_2$ gas pressure **[bar]** | $N_2$ Gas Temp. **[°C]** | Nozzle stand-off distance **[mm]** | Powder feed rate **[rpm]** | No. of spray passes | Catalyst coating weight **[g]** |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.08 | 300 | 40 | 700 | 30 | 0.50 | 4 | 0.55 |
| 2 | 3.15 | 300 | 40 | 700 | 30 | 0.50 | 8 | 1.00 |
| 3 | 3.12 | 300 | 40 | 700 | 30 | 0.80 | 4 | 1.08 |
| 4 | 3.20 | 300 | 40 | 700 | 30 | 0.80 | 4 | 0.67 |

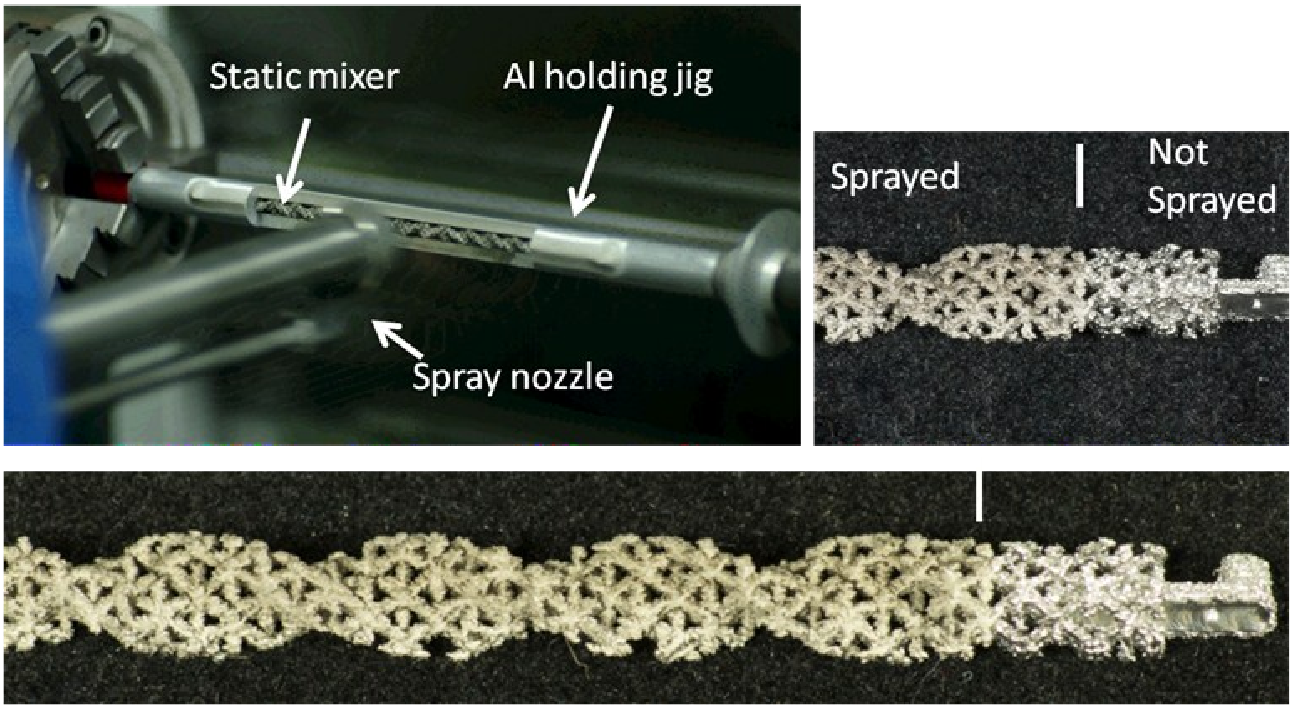


**Fig. S1.** Cold spray method for coating nickel onto a 3D printed metal scaffold.

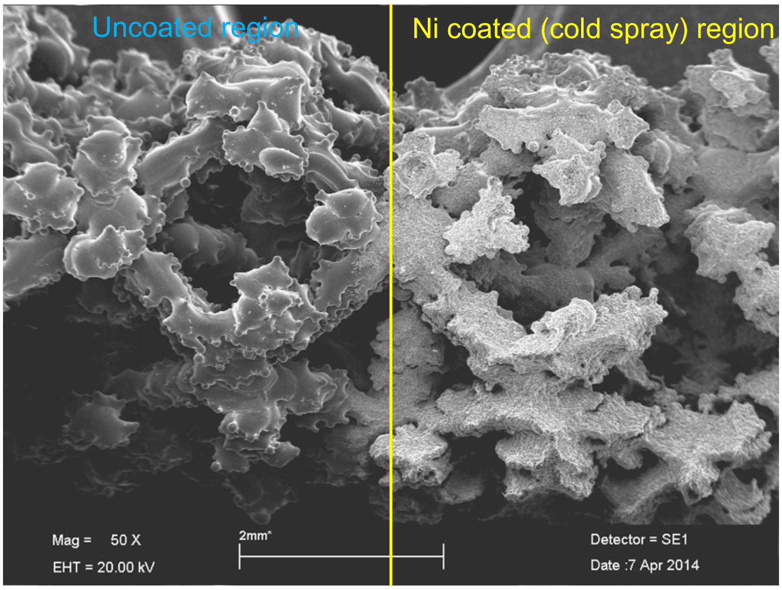


**Fig. S2.** SEM image of cold sprayed nickel coating on 3D printed scaffold (Ti-6Al-4V).