RSDT Fuel Cell Electrodes

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Proton OnSite

The Technology:

Reactive Spray Deposition Technology (RSDT)

- Combines both catalyst production and electrode formation into single step process
- Vapor based deposition allows for various micro-structures by tuning input parameters
- Platinum nanoparticles deposited onto substrate

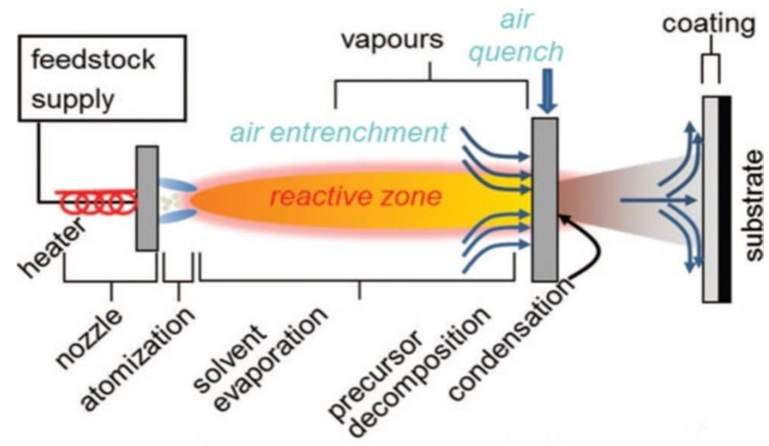

Figure 1: Schematic of the RSDT process used to coat substrates with platinum nanoparticles

The Market:

Figure 2: A 400 kW fuel cell station installed on UConn Depot campus

Figure 3: Fueling a H_2 powered, fuel cell Toyota Highlander prototype at Proton OnSite

Energy Production and Distribution

- High demand: industrial, residential, transportation, electricity
- Utilization of fuel cell energy to meet the increased demand
- Clean, renewable, efficient source

Objective: to reduce the platinum group metal loading for anodes and cathodes used in PEM water electrolysis by 20x and the power consumption of manufacturing MEAs by 50%

Methods:

- Precursor solution (Pt II acetylacetonate) prepared inside high pressure vessel
- O_2 and CH_4 used as pilot gases for transport, flow through atomizing nozzle
- RSDT method: inexpensive solutions, roll to roll process, high degree of control

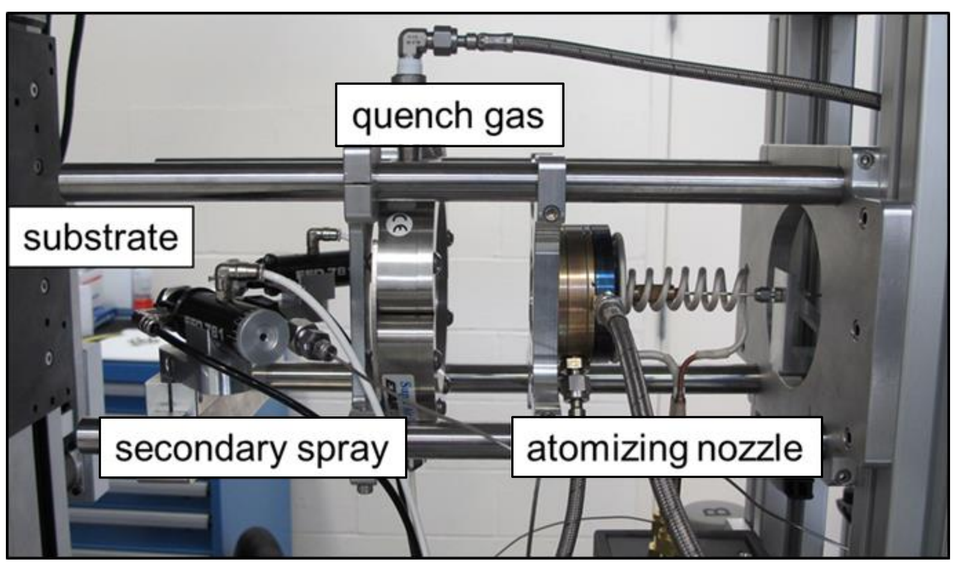

Figure 4: Photo of RSDT open atmosphere machine. Platinum nanoparticles exit atomizing nozzle (right) and are deposited onto substrate material (left)

Results:

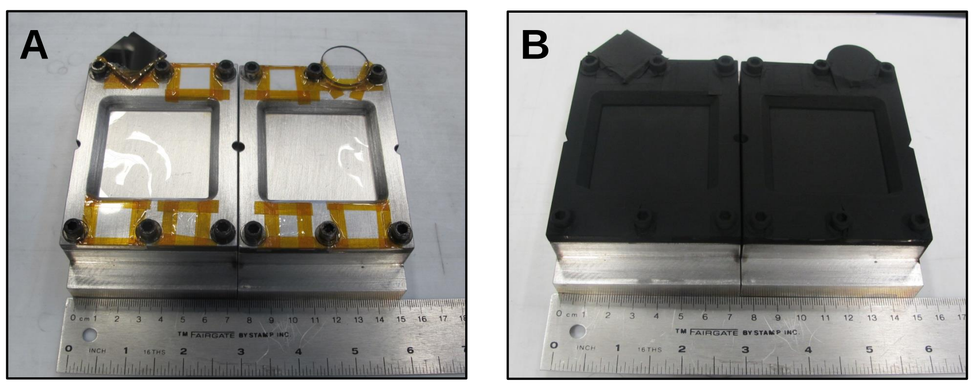

Figure 5: Substrate materials seen (A) before and (B) after two hour deposition

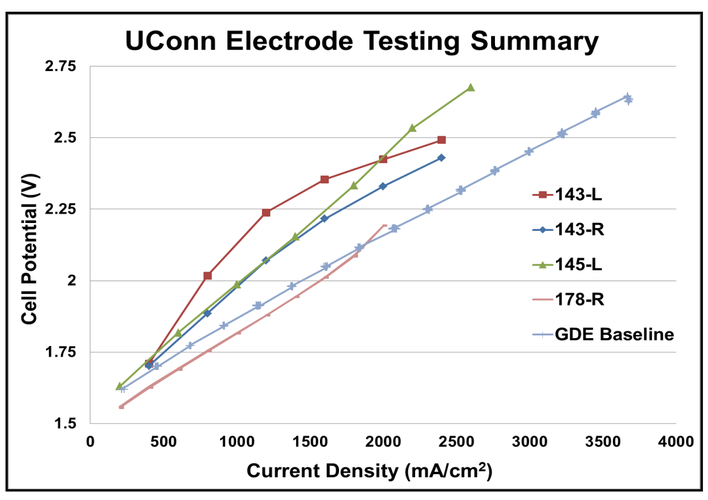

Figure 6: Plot cell potential vs. current density for several RSDT electrodes. Proton GDE (gas diffusion electrode) baseline shows industry standard

Table 1: Experimental data for RSDT and Proton GDE baseline electrodes. Power consumption and loading significantly lower for the RSDT electrodes

Sample #	Average Potential (V)	Loading (mg/cm^2)	Power (kW)
143-L	2.12	0.082	0.75
143-R	2.08	0.165	1.46
145-L	2.31	0.106	1.23
178-R	1.95	0.134	1.84
Baseline	2.18	3.078	3.89

Conclusions:

- Manufacturing electrodes using RSDT reduces platinum group metal loading by more than 20x
- Power consumption is reduced by 50% when using RSDT to produce electrodes
- RSDT reduces cost and fabrication processes

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