

## Supplemental information

# PtRu/C catalyst slurry preparation for large-scale decal transfer with high performance of proton exchange membrane fuel cells

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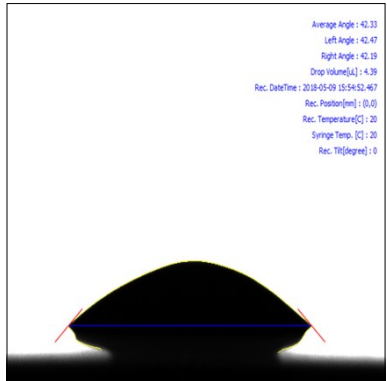
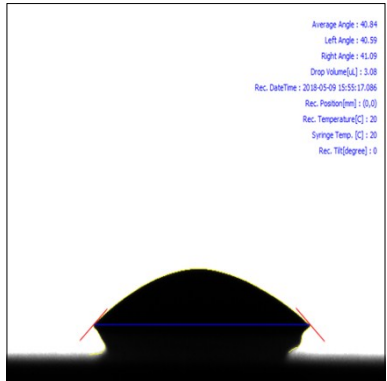
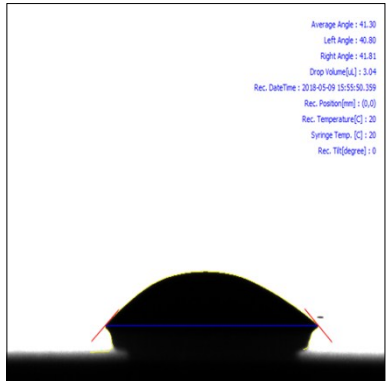
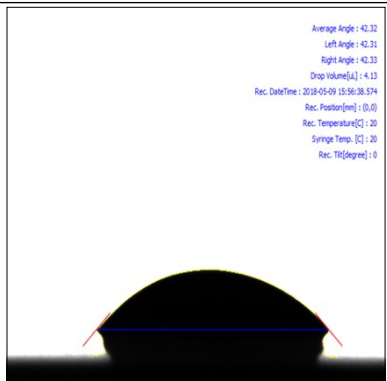
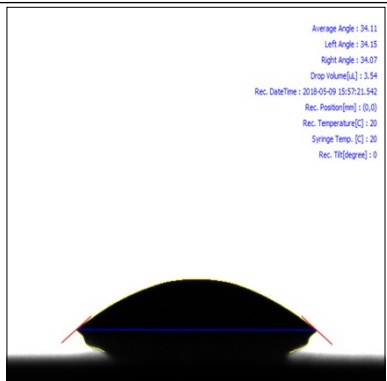
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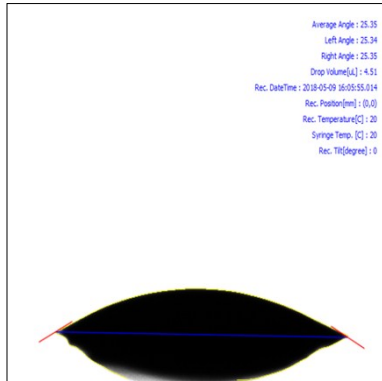
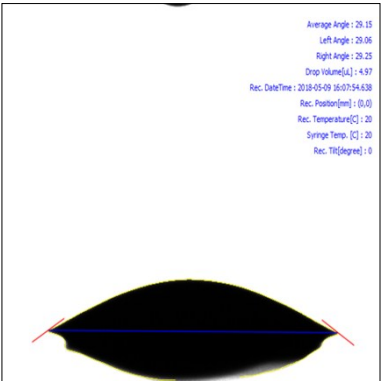
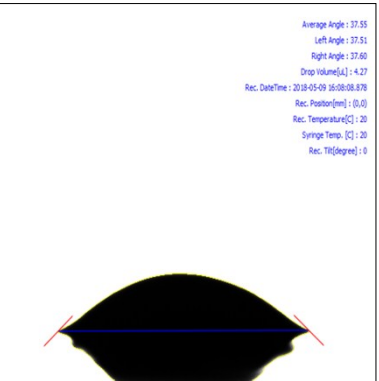
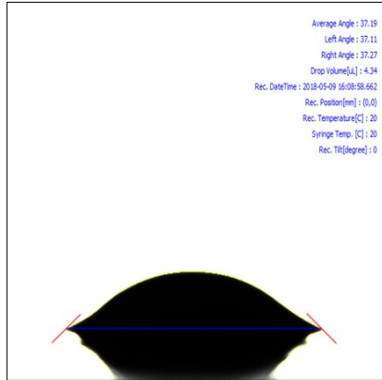
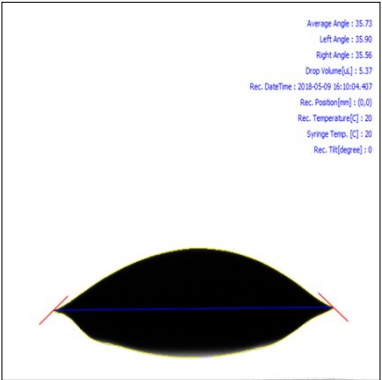
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Figure S1: Contact angle picture of a PtRu/C catalyst slurry drop on a substrate Kapton film.

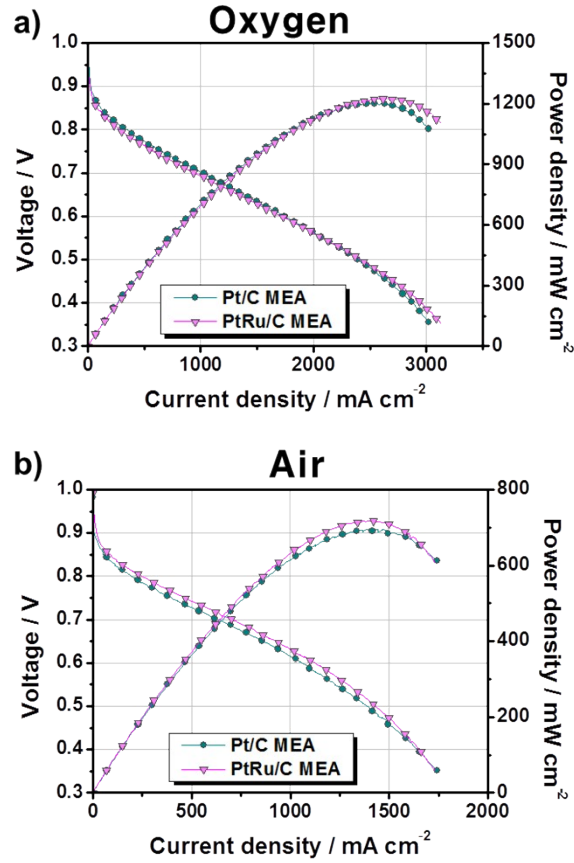
Figure S2: Polarization and power density curves of Pt/C- and PtRu/C-based MEA using decal transfer method.

Run 1	Run 2	Run 3
 <p>Average Angle : 42.33 Left Angle : 42.47 Right Angle : 42.19 Drop Volume[μL] : 4.39 Rec. DateTime : 2018-05-09 15:54:52.467 Rec. Position[mm] : (0,0) Rec. Temperature[°C] : 20 Syringe Temp. [°C] : 20 Rec. TH[degree] : 0</p>	 <p>Average Angle : 40.84 Left Angle : 40.59 Right Angle : 41.09 Drop Volume[μL] : 3.08 Rec. DateTime : 2018-05-09 15:55:17.086 Rec. Position[mm] : (0,0) Rec. Temperature[°C] : 20 Syringe Temp. [°C] : 20 Rec. TH[degree] : 0</p>	 <p>Average Angle : 41.30 Left Angle : 40.80 Right Angle : 41.81 Drop Volume[μL] : 3.54 Rec. DateTime : 2018-05-09 15:55:50.359 Rec. Position[mm] : (0,0) Rec. Temperature[°C] : 20 Syringe Temp. [°C] : 20 Rec. TH[degree] : 0</p>
Run 4	Run 5	
 <p>Average Angle : 42.32 Left Angle : 42.31 Right Angle : 42.33 Drop Volume[μL] : 4.13 Rec. DateTime : 2018-05-09 15:56:38.574 Rec. Position[mm] : (0,0) Rec. Temperature[°C] : 20 Syringe Temp. [°C] : 20 Rec. TH[degree] : 0</p>	 <p>Average Angle : 34.11 Left Angle : 34.15 Right Angle : 34.07 Drop Volume[μL] : 3.54 Rec. DateTime : 2018-05-09 15:57:21.542 Rec. Position[mm] : (0,0) Rec. Temperature[°C] : 20 Syringe Temp. [°C] : 20 Rec. TH[degree] : 0</p>	
Sample	Run #	Contact angle / °
PtRu/C in IPA	1	42.3
	2	40.8
	3	41.3
	4	42.3
	5	34.1
	Standard deviation	3.5
	Coefficient of variation	8.60
	<b>Average</b>	<b>40.2</b>

**Figure S1a:** Contact angle picture of a PtRu/C catalyst slurry drop on a substrate Kapton film; PtRu/C in isopropyl alcohol (IPA) dispersion.

Run 1	Run 2	Run 3
		
Run 4	Run 5	
		
Sample	Run #	Contact angle / °
PtRu/C in MeOH	1	25.4
	2	29.2
	3	37.6
	4	37.2
	5	35.7
	Standard deviation	5.5
	Coefficient of variation	16.54
	<b>Average</b>	<b>33.0</b>

**Figure S1b:** Contact angle picture of a PtRu/C catalyst slurry drop on a substrate Kapton film; PtRu/C in methanol (MeOH) dispersion.



	Current density at 0.6V (mA cm <sup>-2</sup> )	Maximum Power Density (mW cm <sup>-2</sup> )	Current density at 0.6V (mA cm <sup>-2</sup> )	Maximum Power Density (mW cm <sup>-2</sup> )
Pt/C MEA	1741	1202	1067	696
PtRu/C MEA	1722	1224	1146	747

**Figure S2:** Polarization and power density curves of Pt/C- and PtRu/C-based MEA using decal transfer method under a) H<sub>2</sub> / O<sub>2</sub> and b) H<sub>2</sub> / air. The active cell area was 5.0 cm<sup>2</sup> and test was performed at 70 °C and fully humidified H<sub>2</sub> and O<sub>2</sub> / air were used in the MEA under atmospheric pressure. The anode was commercial PtRu/C (53.5 wt.% TTK Catalyst, 0.20 mg<sub>Pt</sub> cm<sup>-2</sup>) and the cathode catalyst was a commercial Pt/C (40.0 wt.% JM Catalyst, 0.30 mg<sub>Pt</sub> cm<sup>-2</sup>)