measurment conditions are impracticable for particular systems). As is well-known, this technique measures the surface composition, as well as some thickness below the surface.

[0331] Six channels (two sets of 3 channels) were analyzed. From each set of 3 channels there were 2 channels on an edge of the device and one in the middle. The coatings in the six channels were analyzed at the top and bottom (with respect to gravity during washcoating) of the coated section. The wt % Pt in each channel are shown below:

	Channel No.					
	1	2	3	4	5	6
top	42	38	42	25	28	29
bottom	46	33	41	52	45	61

[0332] As can be seen, there was not a consistent trend in every microchannel. In the second set of microchannels (4, 5, 6) there appears to have been a problem with filling, draining, or both. The second set of channels contained about twice as much coating at the bottom of the channel than at the top. Perhaps, during the washcoating stage, the first set of channels drained efficiently, while the second set did not. There also appeared to be an effect in which the outer microchannels contained more coating, perhaps due to slower draining of these channels. For this data, the variability for one standard deviation exceeds 40% of the mean value for both the top and the bottom of the six channels.

[0333] Both interchannel and intrachannel deviation can be described in terms of standard deviations around the mean. Assuming a normal gaussian distribution of catalyst loadings from channel to channel and within a channel, 68% of all channels will be within 1 standard deviation of the mean; 95% of all channels will be within 2 standard deviations of the mean, and 99.7% of all channels will be within 3 standard deviations of the mean.

[0334] For another set of analyzed channels, wide variability from channel to channel and along the length of the channel was measured. Channel-to-channel variability of the Pt catalyst for a set of 3 channels analyzed at 4 axial locations had a standard deviation of 2 around a mean of 27% at the tops of the channels. Uniformity to within 1 standard deviation would give an intercahnnel variability of about +/−15%. Uniformity to within 2 standard deviations would give an interchannel variability of about +/−22%. Uniformity to within 3 standard deviations would give an interchannel variability of about +/−45%. The Pt catalyst variability at the bottom of the channel gives a mean of 52% Pt and a standard deviation of 8. Uniformity to within 1 standard deviation would give an intercahnnel variability of about +/−30%. Uniformity from channel to channel at the bottom of the channel to within 2 standard deviations would give an interchannel variability of about +/−61%. Uniformity to within 3 standard deviations at the channel bottom would give an interchannel variability of about +/−92%. In all cases, the degree of Pt catalyst uniformity, as defined to witin 2 standard deviations, exceeds 20% in all cases. The variability is higher at the bottom of the channels as expected because the uniformity is exacerbated by differences in draining from channel to channel. The channels that are closer to the drain ports are expected to drain first and have less material accumulation for longer times than those channels farther away from the drain ports.

[0335] The intrachannel variablitity was also quite high for this device. The average variability accross the 3 channels to within 1 standard deviation slightly exceeds 50%. This data then suggests that roughly two-thirds of the channels have a variability near 50%, while one-third of the channels would be expected to have a much larger variability.

[0336] The target uniformity for both interchannel and intrachannel catalyst loading is within 20% to achieve the target process performance. Uniformity may be measured by assessing performance to within 2 standard deviations as measured in a device.

[0337] The described invention overcomes the coating uniformity challenges observed in this example. Intrachannel uniformity is particularly advantaged when the dominant forces acting on the washcoating fluid are surface forces not gravitational forces. Gravitational forces that acted on the washcoating fluid in this example thinned the top of the retained liquid layer and gave rise to high intrachannel non-uniformity. Surface forces, including capillary, adhesion, or chemical reaction act to retain the fluid evenly or nearly evenly along the channel length. In addition, the described example demonstrated poor interchannel uniformity. The described invention shows that the interchannel uniformity is dominated by the processing methods by which the device is filled and drained with the washcoating solution. One solution is to use capillary features which will hold up the fluid when it arrives at the microchannel wall. This method is less sensitive to the time that a fluid spends elsewhere in the device while filling and draining. With that said, it is anticipated that a gaseous purge less than about 1 SLPM per channel is required to blow out excess material at the end of the microchannel after the draining process. Preferably, the gaseous purge is less than 0.5 SLPM per microchannel. More preferable, the gaseous purge is less than 0.1 LPM per microchannel and in some embodiments is substantially zero. Other surface forces approaches, including adhesion and chemical reaction and electrochemical reactions, may be more susceptible to non-uniformity arising from the filling and draining process. Uniformity will be particularly advantaged, when the fluid is essentially in place or filled within a channel to the desired liquid level before the surface forces act substantially. Conversely, it is desired to reduce the rate of the surface forces prior to removing or draining the washcoating fluid from the microchannel. For both the case of the adhesive or chemical reaction one option would be to fill and drain the channels at a first temperature that is substantially below a second temperature where the washcoating fluid and wall interact or react to deposit or retain washcoating fluid. The second temperature is at least 10 C higher than the first temperature and preferably 20 C or more higher. For the case of a chemical reaction, the washcoating fluid may be allowed to react to extinction and thus non-uniform coatings are unlikely during the draining process and no temperature reduction is required during draining. The microchannels containing the washcoating fluid are adjacent to a second set of parallel microchannels that are used during the operation of the chemical process such as a chemical reactor. This second set of microchannels may be particularly advanta-