Maggie Paran
MEGN 469
11/27/2017

HW 12: Planar SOFC Stack Design, Part 2

PART I:

5 channels (length = 2.50 cm), I = 12.66 A

For 15 A-rated cell:

Active Area = 6.25 cm2
Cell Area = 7.81 cm2
Power = 9.49 W
Current = 12.66 A

9 channels (length = 4.50 cm), I = 37.65 A

For 40 A-rated cell:

Active Area = 20.25 cm2
Cell Area = 25.31 cm2
Power = 28.23 W
Current = 37.65 A

14 channels (length = 7.00 cm), I = 87.66 A

For 100 A-rated cell:

Active Area = 49.00 cm2
Cell Area = 61.25 cm2
Power = 65.74 W
Current = 87.66 A

21 channels (length = 10.50 cm), I = 198.97 A

For 200 A-rated cell:

Active Area = 110.25 cm2
Cell Area = 137.81 cm2
Power = 149.23 W
Current = 198.97 A

PART II:

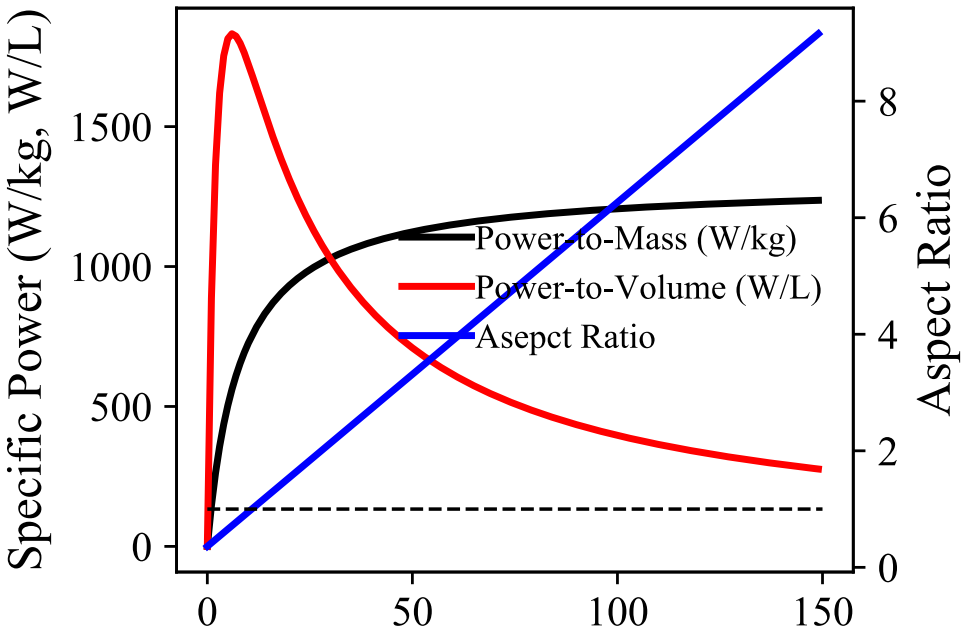

Figure 1: 15-Amp Class Device

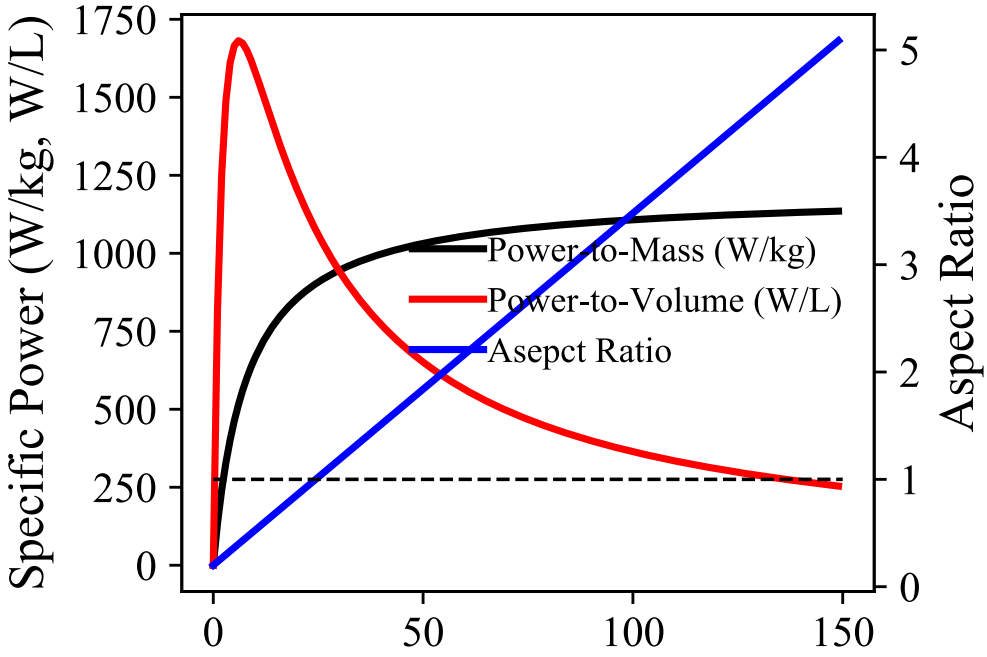

Figure 2: 40-Amp Class Device

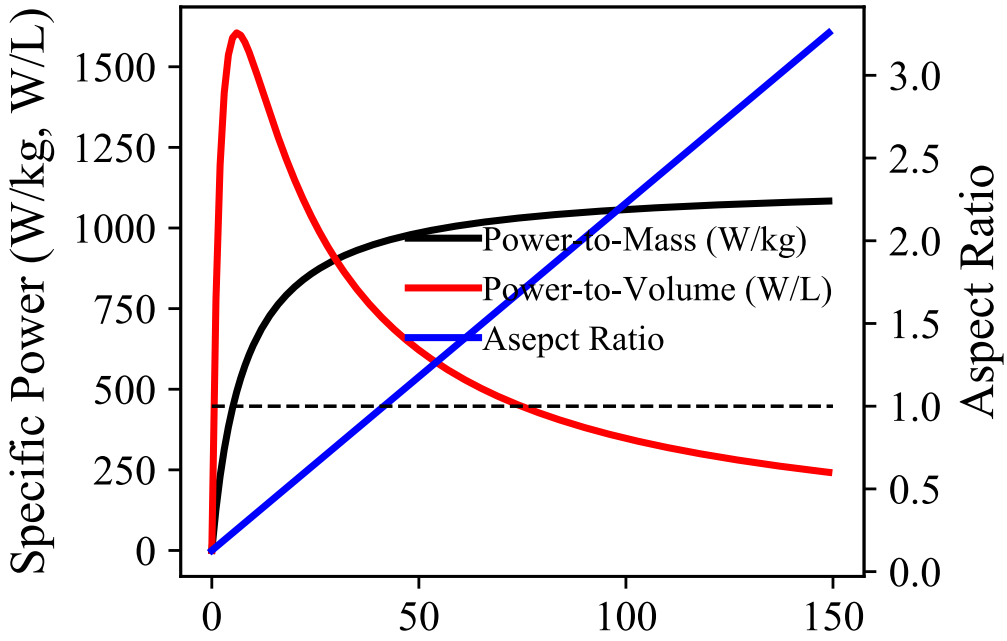

Figure 3: 100-Amp Class Device

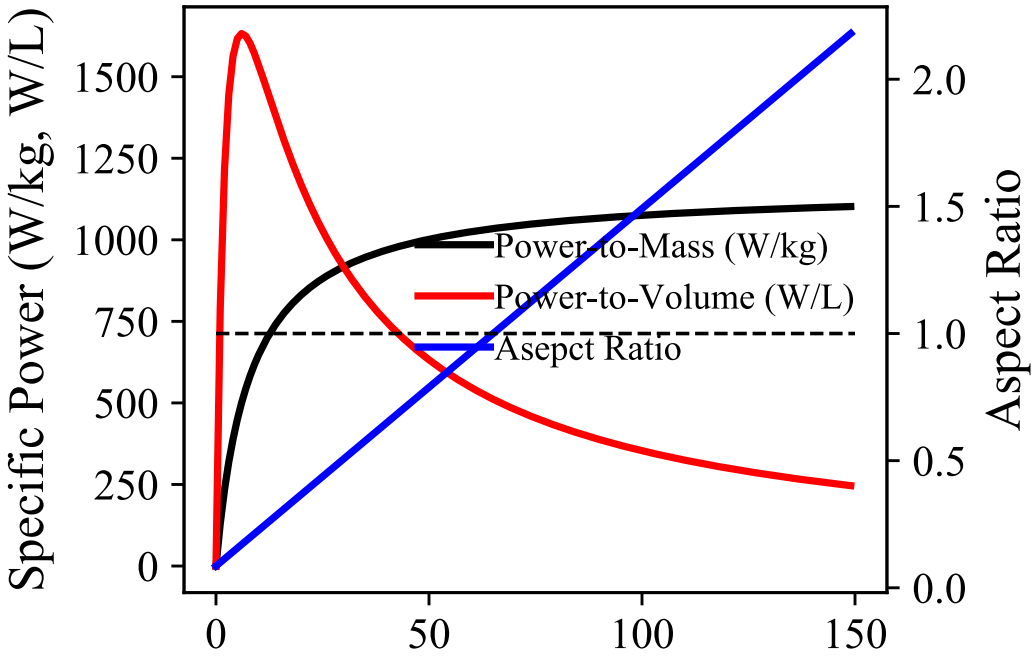

Figure 4: 200-Amp Class Device

Stack Class	Number of cells	Stack Power (W)	Stack Mass (kg)	Stack Volume (L)	Stack Power-to-Mass Ratio (W / kg)	Stack Power-to-Volume Ratio (W / L)
15 Amp	12	104.39	0.138	0.06	756.691	1680.775
40 Amp	25	677.52	0.754	0.62	898.495	1085.904
100 Amp	43	2761.08	2.876	3.89	959.948	710.262
200 Amp	66	9699.95	9.377	18.96	1034.394	511.555

Table 1: Summary data for each class of stack at an aspect ratio of 1.0

Discussion:

The data in Table 1 shows that at an aspect ratio of 1.0, as cell current increases, then the stack power-to-mass ratio increases and stack power-to-volume ratio decreases. Stack volume increases at a faster rate than stack mass when more cells are added to the stack. These trends are supported and shown graphically in figures 1-4. Regardless of the stack current class device value, there is a general trend that holds throughout figures 1-4, it is maintained that as the number of cells increases, the power-to-volume curve in red exponentially decreases, while the power-to-mass curve in black gradually increases, but then begins to slightly plateau. Nonetheless, these curves still differ at different operating currents. Although the range for the power-to-mass and power-to-volume ratios becomes larger (or is on a larger scale) at higher operating currents; it observed that from figures 1 to figures 4 the power-to-mass curve progressively gets closer to the dotted line that indicates an aspect ratio of one.

The trade-offs with these trends is that if the goal is to have more power then the number of cells must increase but this makes the cell heavier. On the other hand, if the goal is to make the cell lighter then the number of cells should decrease which means there is less power.