DMFCs FOR PORTABLE POWER APPLICATIONS

(Poster)

Piotr Zelenay

Materials Science & Technology Division
Los Alamos National Laboratory

Major Contributors to LANL
DMFC Portable Power Stack Effort in 2001/2002

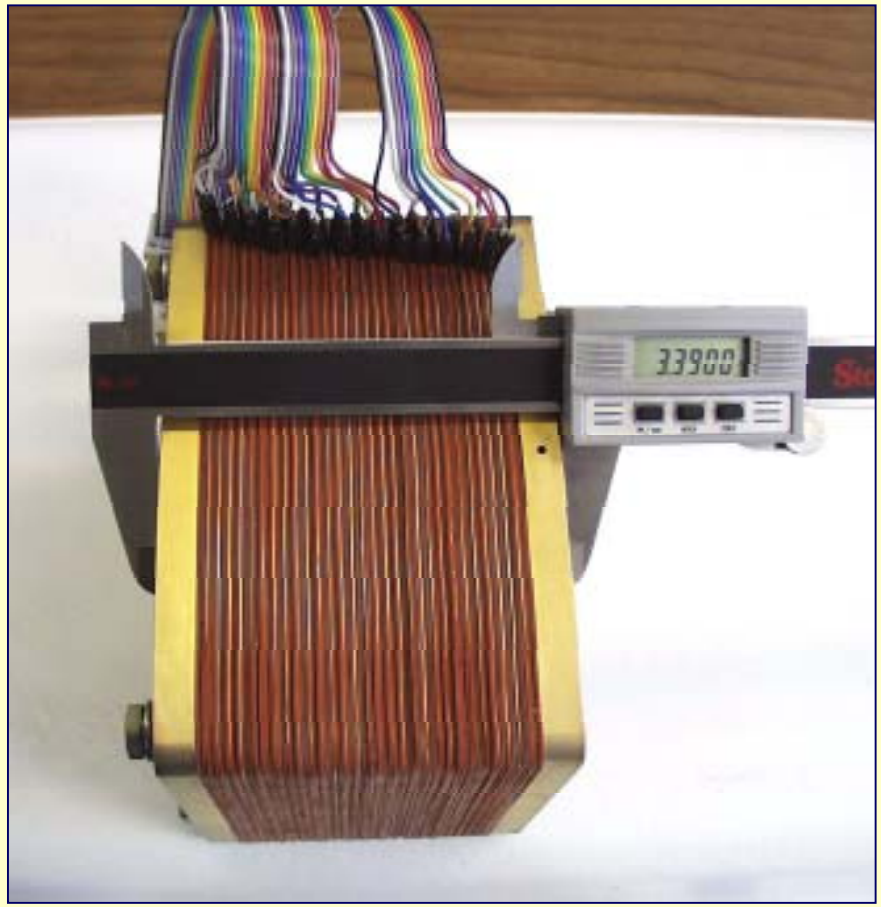
John Davey	-	Technical Support
Robert Fields	-	Controls & Software
François Le Scornet	-	MEAs & Testing
Don McMurry	-	Controls & Software
Bryan Pivovar	-	MEAs & Testing
Gerie Purdy	-	Technical Support
John Ramsey	-	Hardware Modeling
John Rowley	-	Technical Support
Mahlon Wilson	-	Design & Engineering
Christine Zawodzinski	-	Design & Engineering
Piotr Zelenay	-	Oversight & Testing
Yimin Zhu	-	MEAs & Methanol Sensor

Thanks to high energy content of methanol, the energy density of DMFCs for portable power applications can exceed 1.0 kWh kg^{-1}, *i.e.*, close to one order of magnitude higher than advanced batteries.

Direct methanol fuel cell research at LANL has addressed both automotive and portable use of direct methanol fuel cells ("portable/transportation fuel cells synergy"). In this poster, we focus on devices intended for portable power / APU applications. One smaller section of the poster presents highlights from the already completed first major DMFC stack project for military communications. This collaborative project between LANL and Ball Aerospace (balance of plant, system integration), led to the development of a 80 W stack by Los Alamos and, ultimately, to successful demonstration of a complete 60 W (net) 29%-efficient system to the military in the summer of 2001.

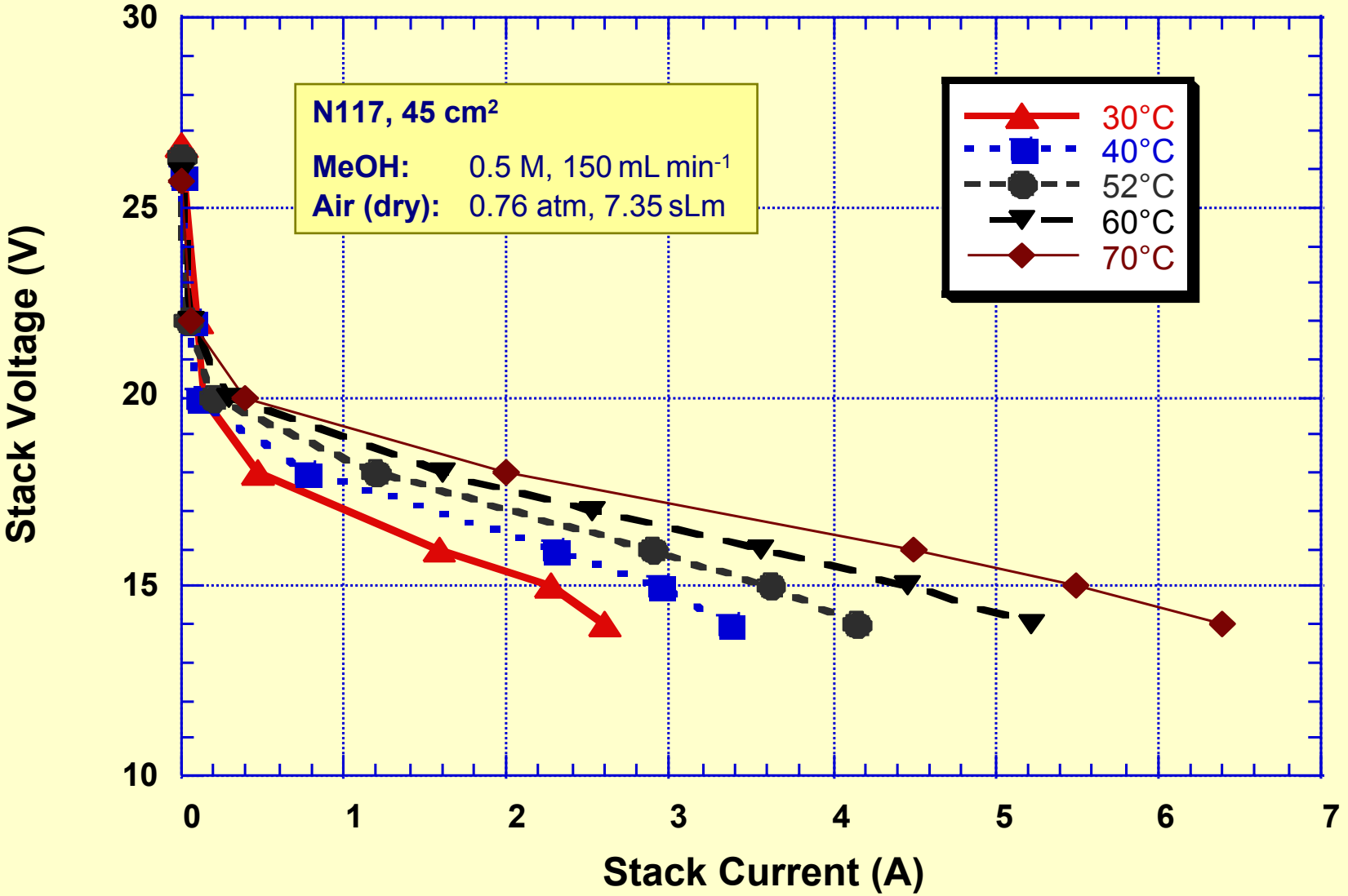
DMFC stacks presently developed at LANL focus on a light and highly-efficient 22 W stack (DARPA Palm Power project with Ball Aerospace) and on a ~ 500 W stack for auxiliary power unit (APU), sponsored by DOE-OAAT. Last-year progress in these projects, which would not have been possible without *major advances in fundamental DMFC research* at LANL over past several years, is shown in the larger part of the poster.

First 80 W DMFC Stack: Military Communications Systems (1999 - 2001)



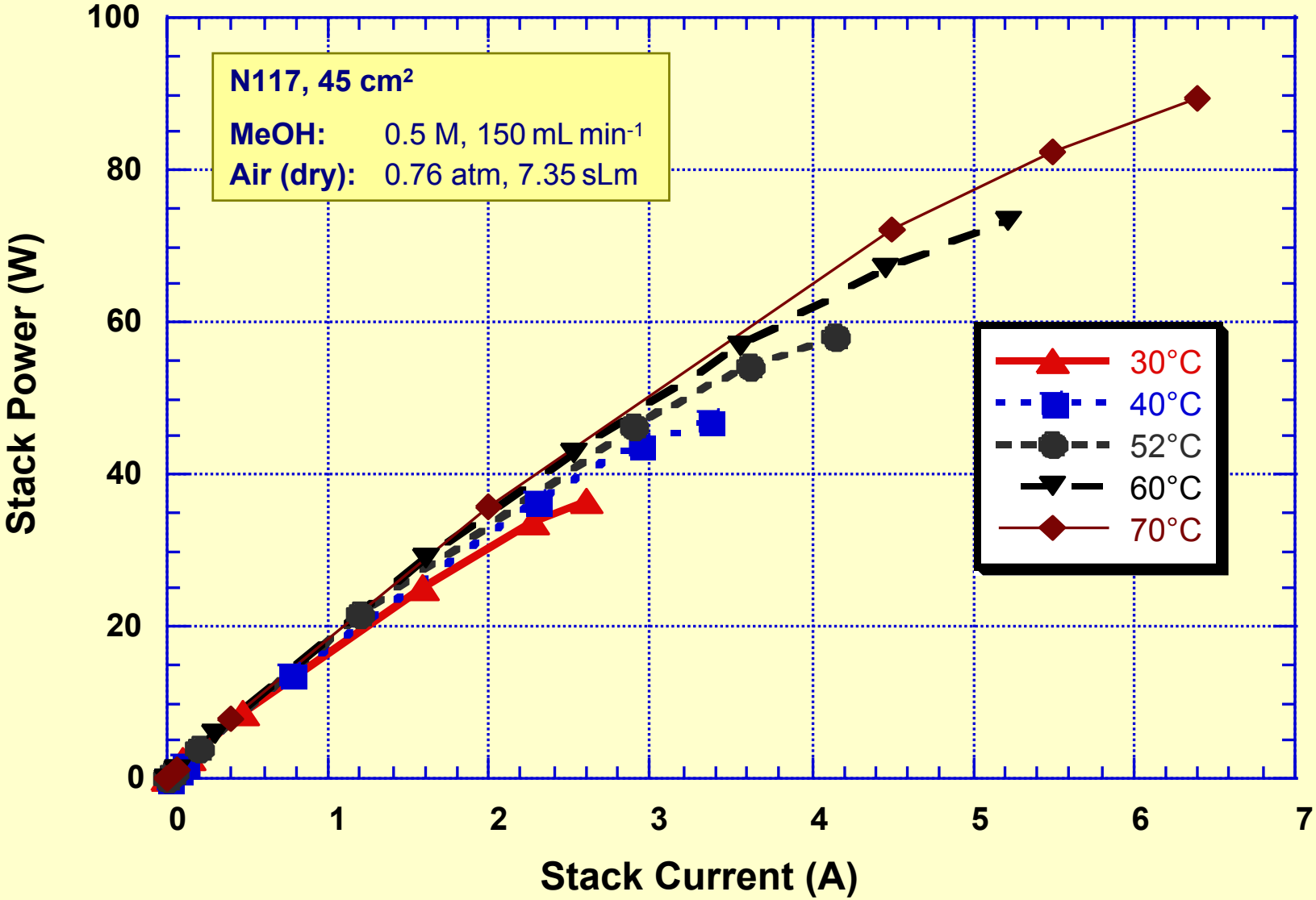
30-cell 45-cm^2 LANL stack (~ 2.0 kg weight)

(X. Ren, J. Davey, H. Dinh, C. Rice, B. Pivovar, P. Zelenay & S. Gottesfeld)



30-cell stack performance at 60°C, 0.76 atm air

(X. Ren, J. Davey, H. Dinh, C. Rice, B. Pivovar, P. Zelenay & S. Gottesfeld)



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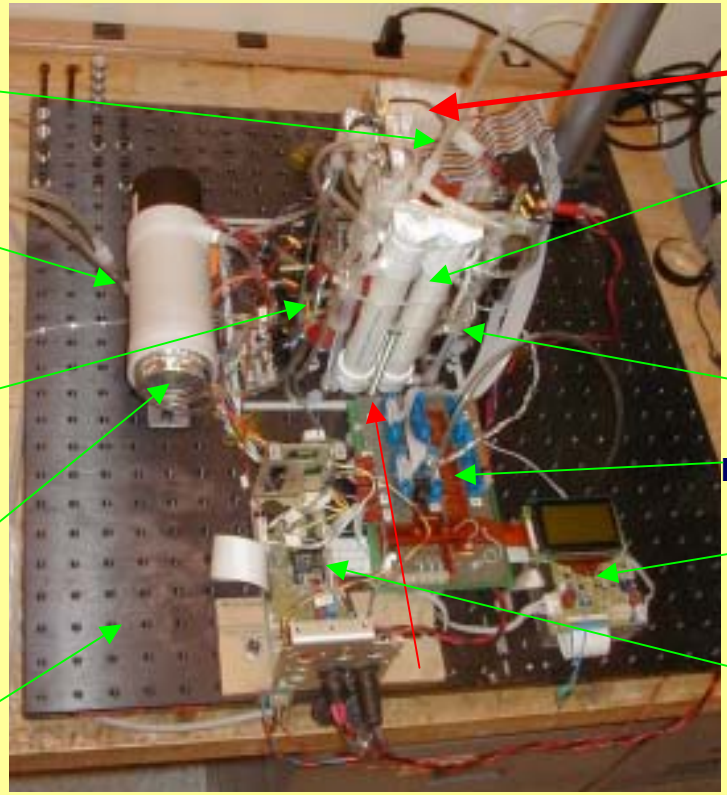


BRASS-BOARD SYSTEM

PACKAGED SYSTEM

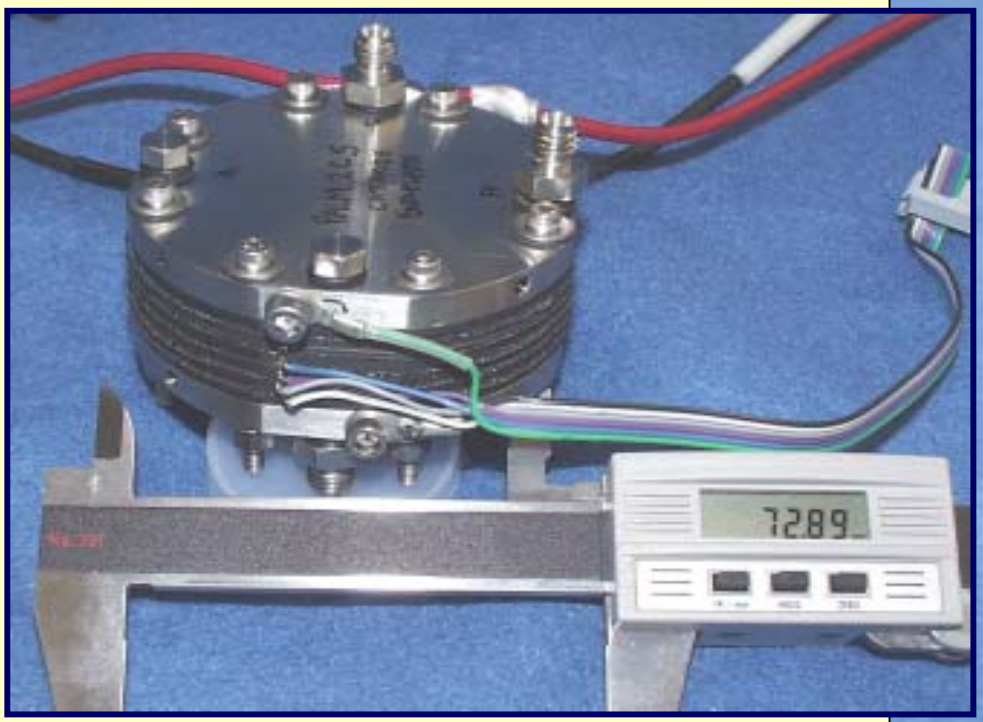
Ball Aerospace brass-board & fully packaged systems

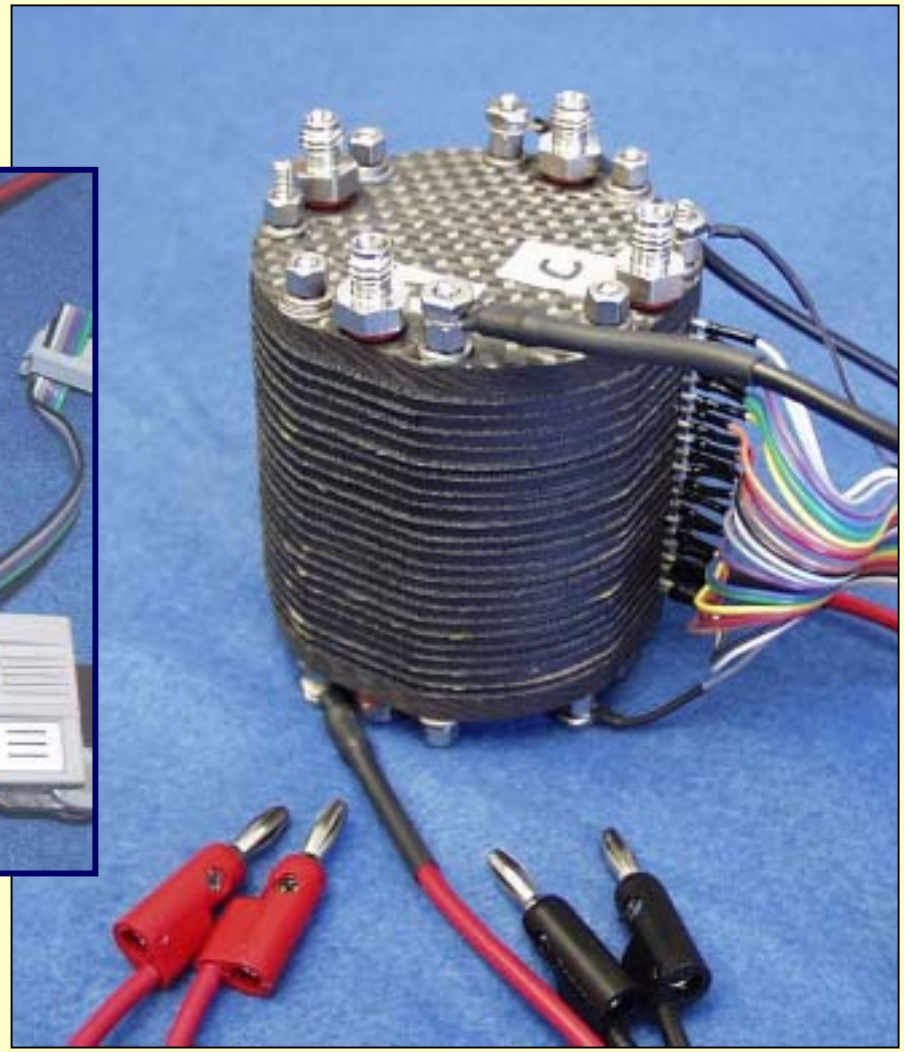
~ 60 W net power generated at 60°C

22 W Palm Power Research

&

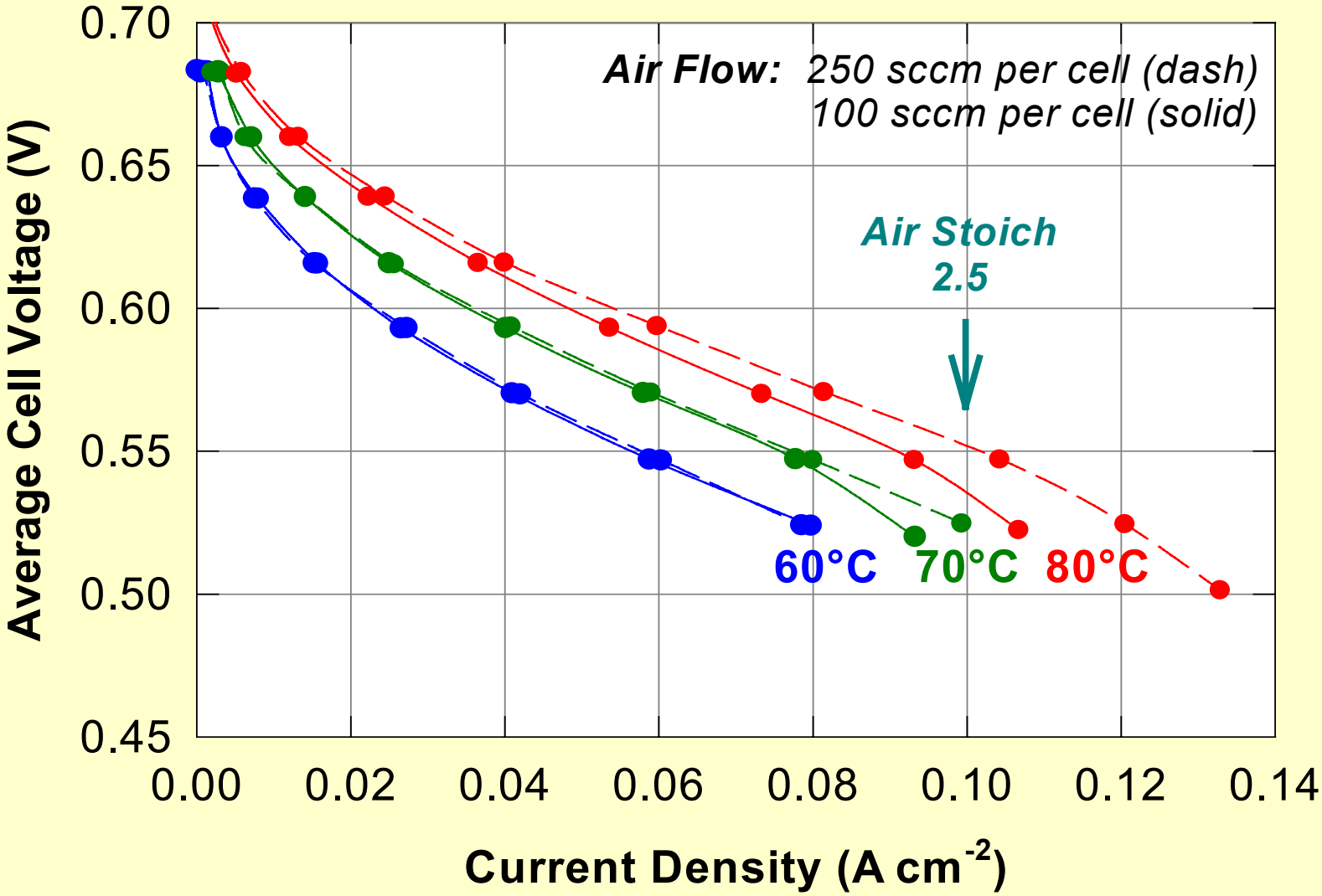
~ 500 W APU Project (*Initial Phase*)





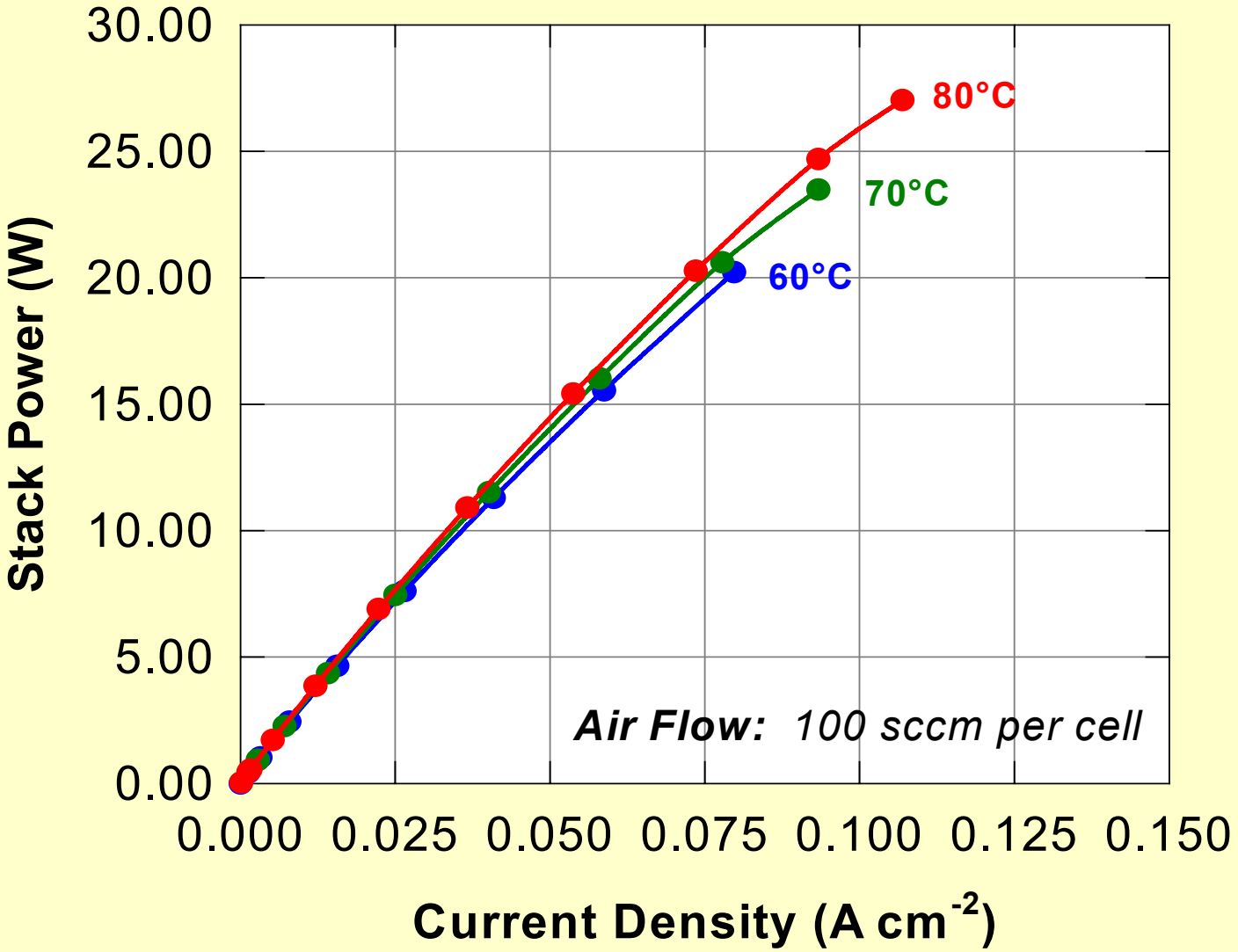
Palm Power Research: **From five-cell stack to 22-cell stack**

Entirely new stack hardware optimized in single-cell testing



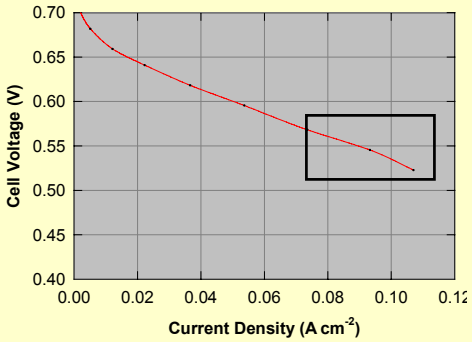
Palm Power Research: 22-cell stack performance

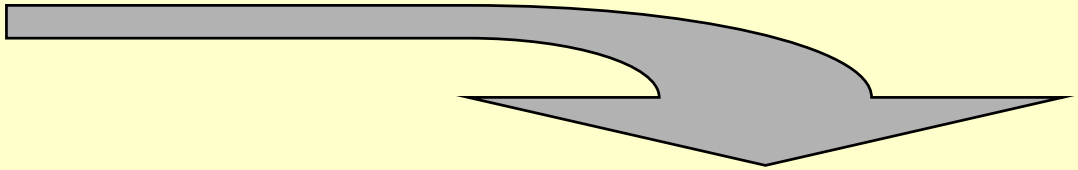
Dry & ambient (0.76 atm) air feed

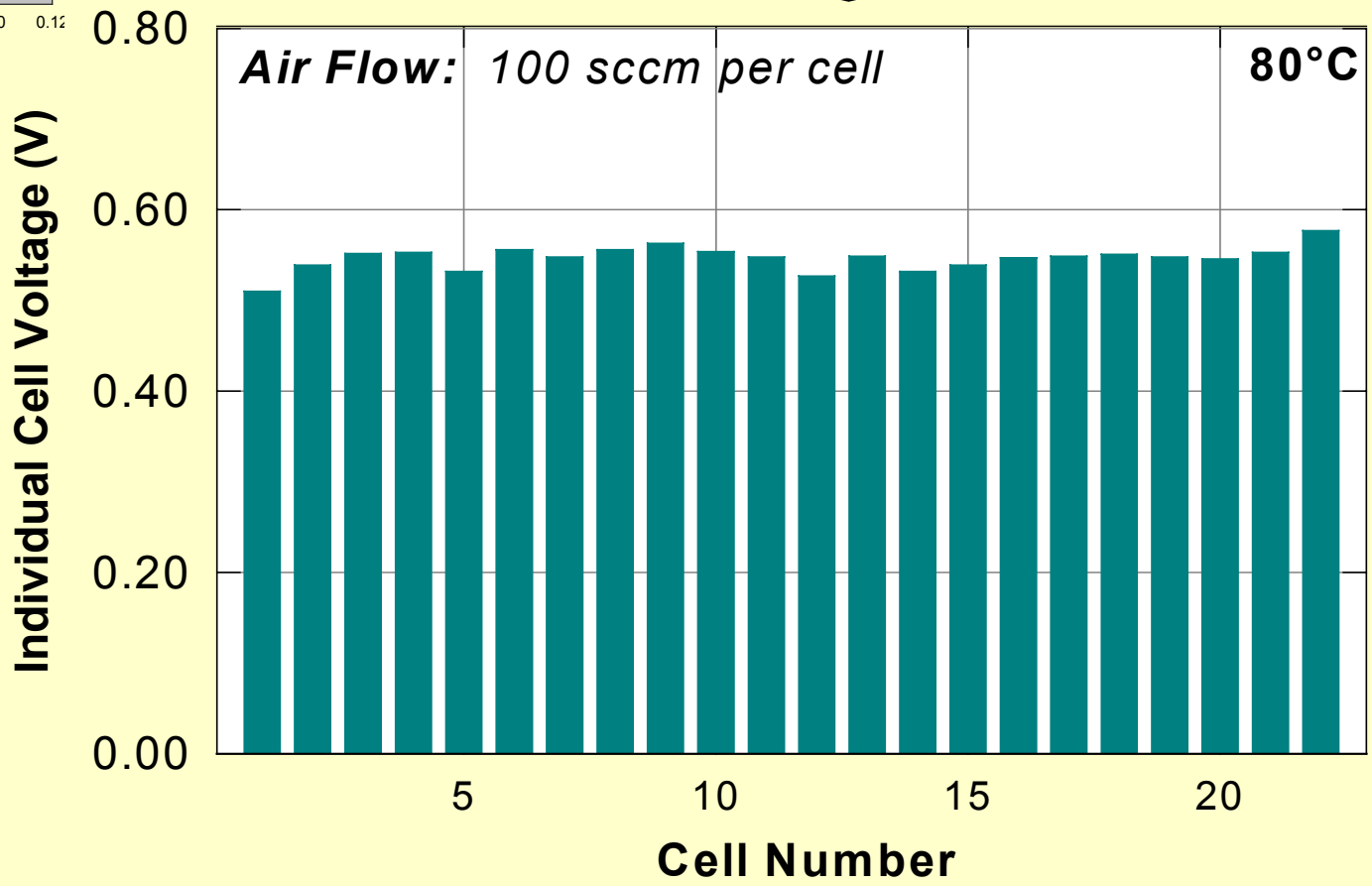


Palm Power Research: Total stack power

Dry & ambient (0.76 atm) air feed

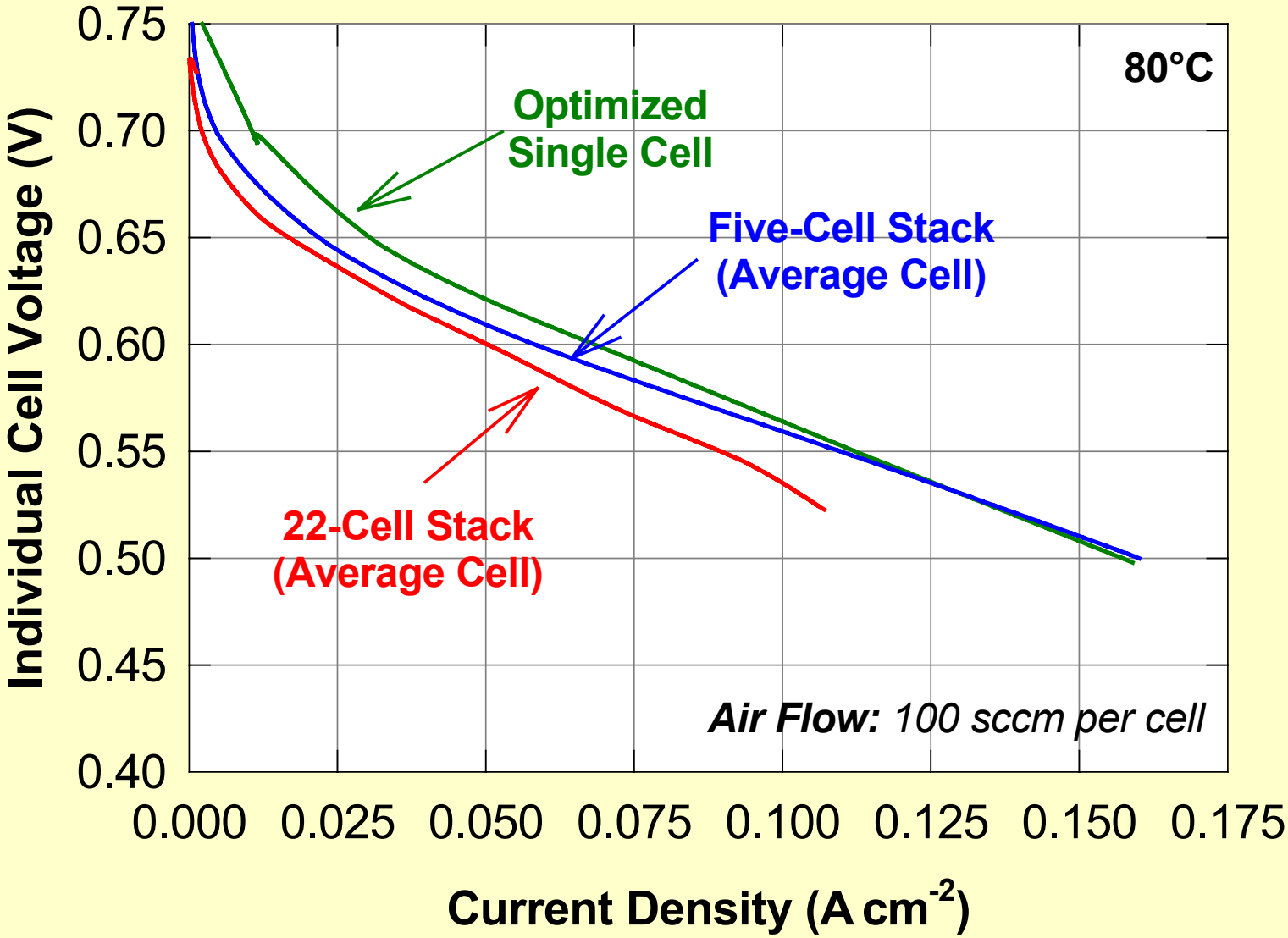






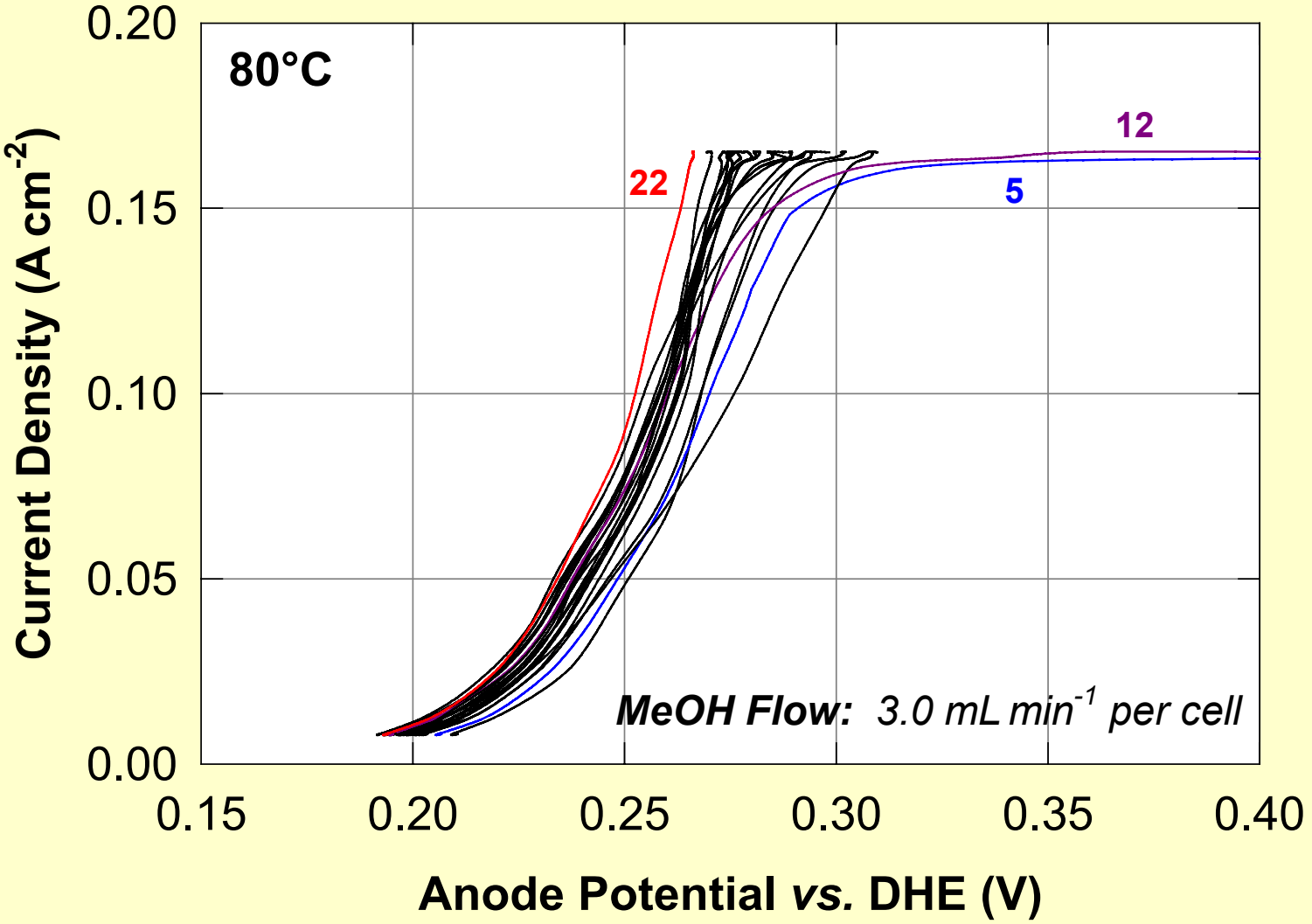
Palm Power Research: Voltage distribution in 22-cell stack

Stack voltage 12.1 V



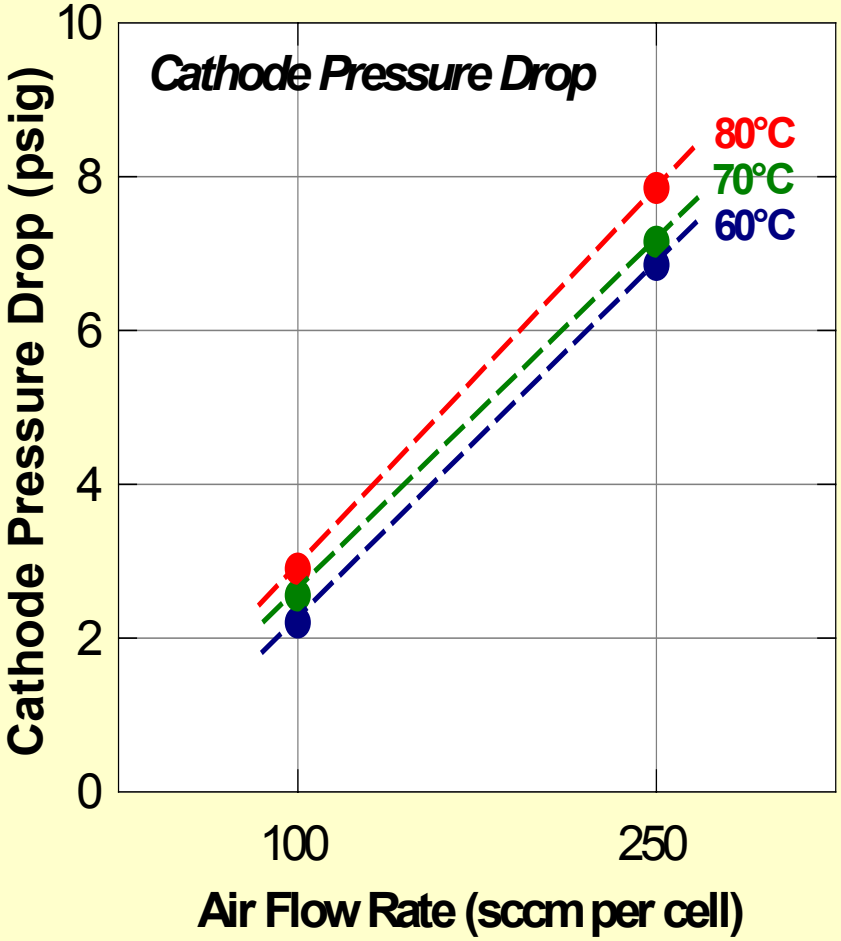
Palm Power Research: Scale-up penalty

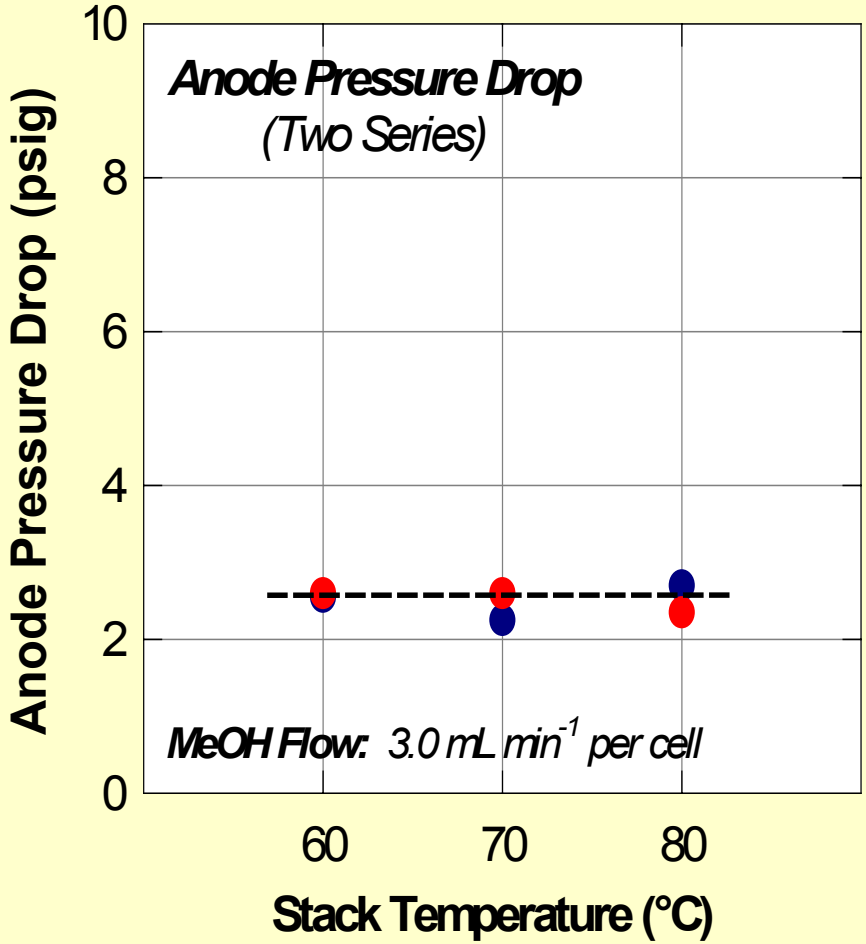
Less than perfect anode and cathode distribution



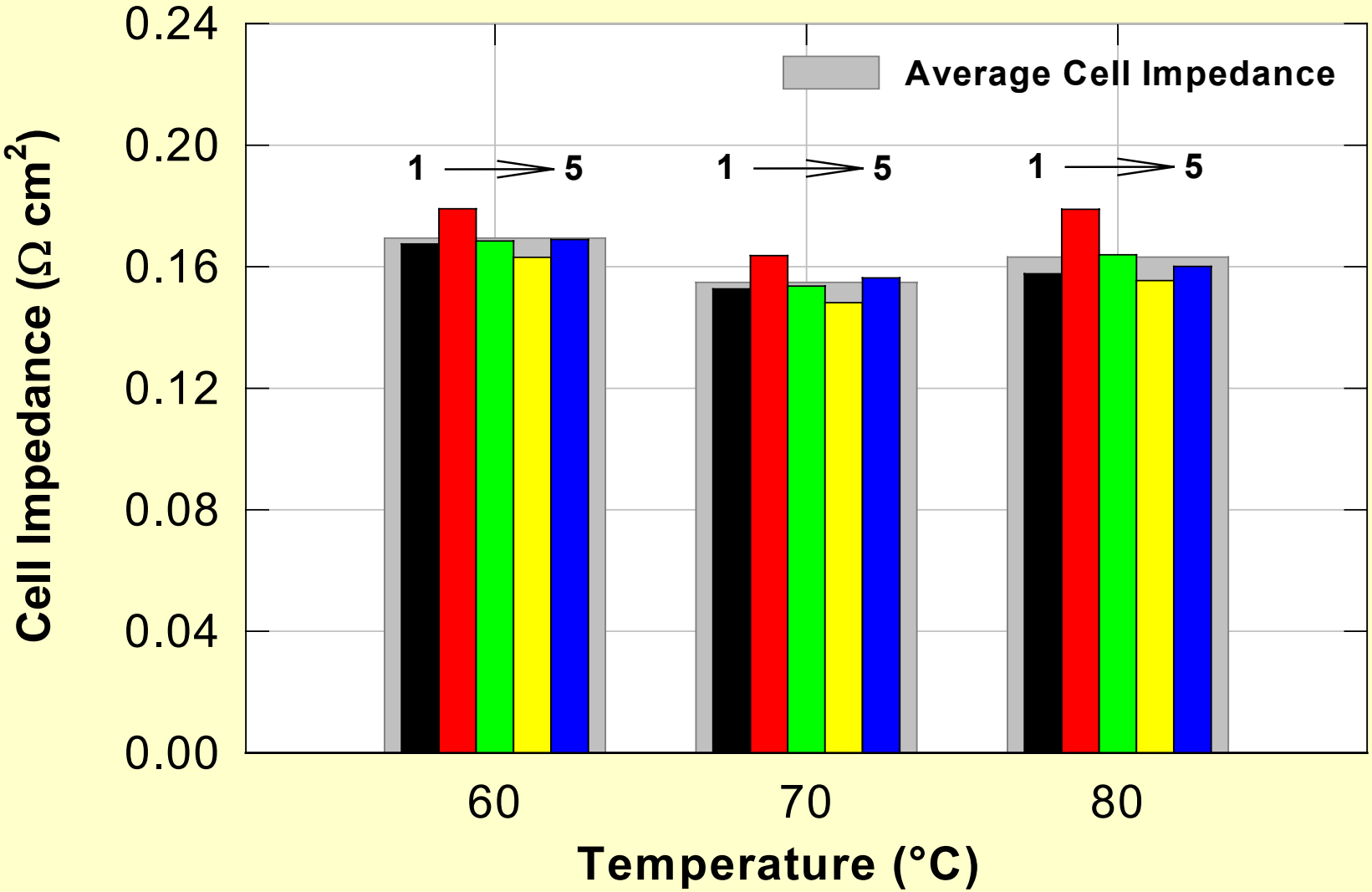
Palm Power Research: **22-cell stack anode polarization plots**

Data show the best- (22) and the worst-performing (5 & 12) anodes





Palm Power Research: **Cathode and anode pressure drops**
22-cell stack

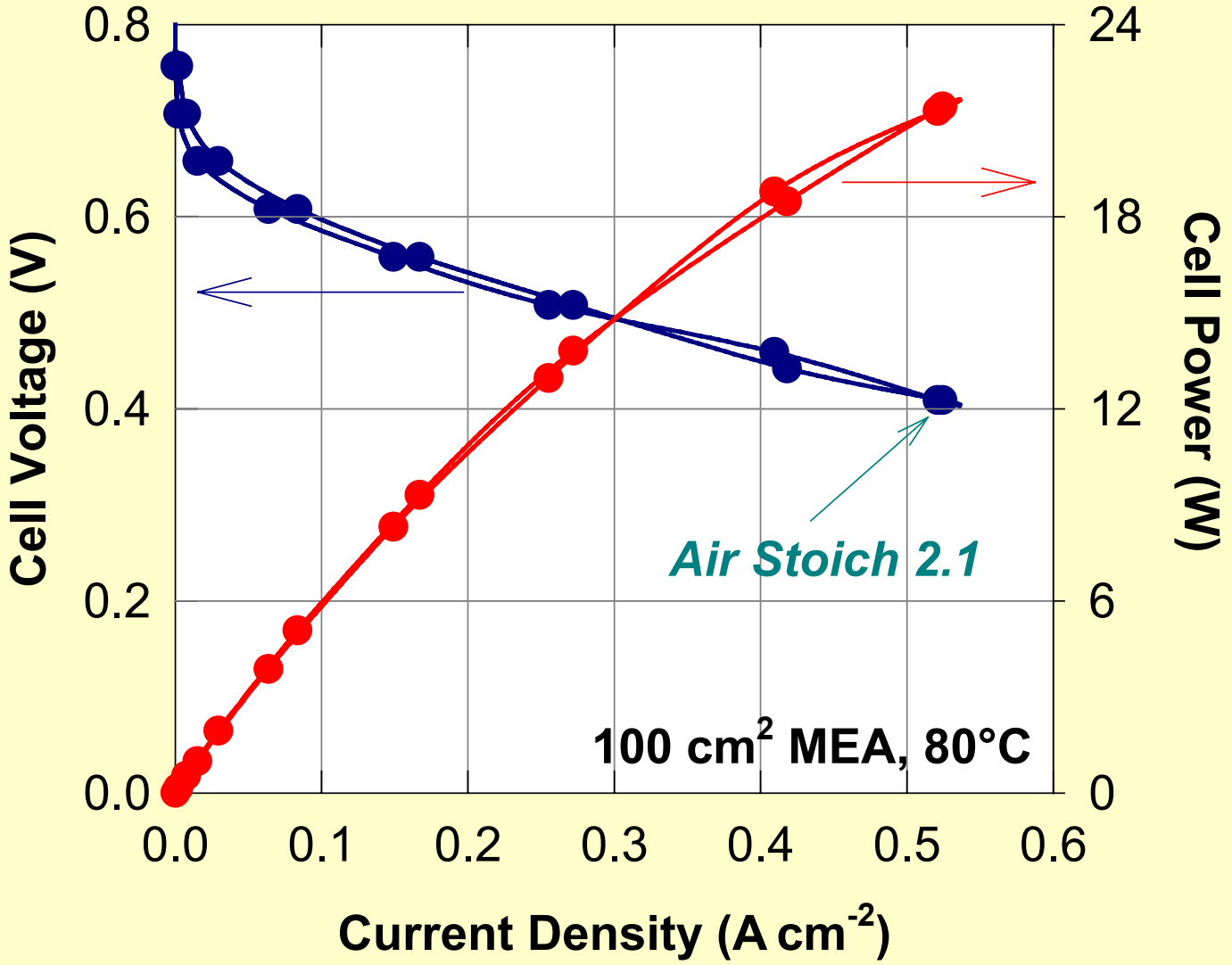


Palm Power Research: Cell impedance at various temperatures

Five-cell stack data shown; ambient & dry air

~ 500 W APU Project: **Initial single-cell testing**

Hardware



~ 500 W APU Project: **Initial single-cell testing**

Performance at 80°C, back-pressurized cathode