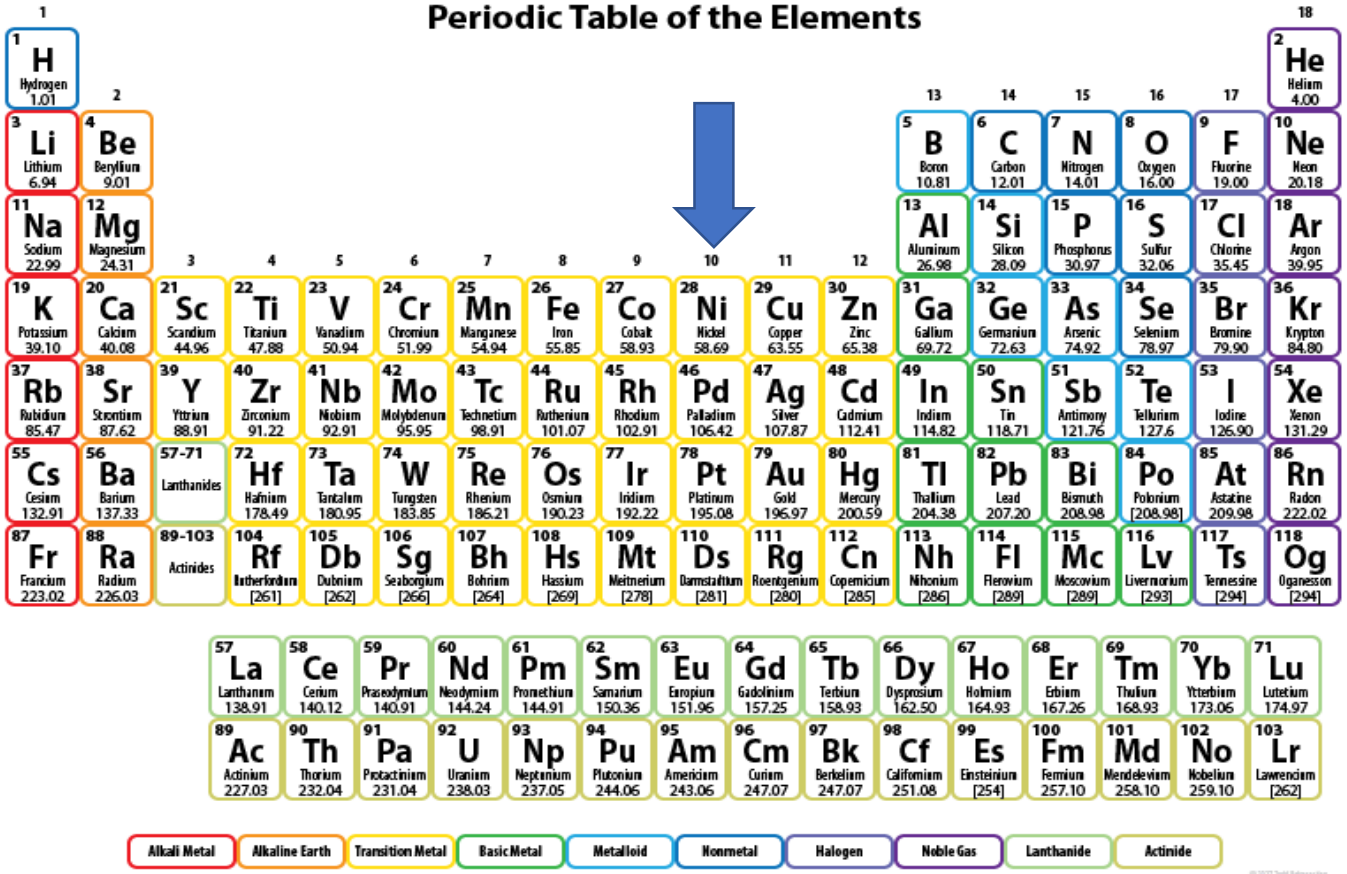
UT ENERGY WEEK 2020

Making Minerals Great Again



UT Energy Week 2020 - Opening Remarks

- Natural resources business inherently risky for investment, debt or equity
  - Capital intensive (1B+)
  - Cost over-runs the “norm”
  - Subject to commodity price swings and technological change
  - Subject to Mother Nature
  - Capital sources (public or private) are unpredictable

- Not all capital is created equal
  - Leverage not a friend of natural resources
  - ROI is more suitable than IRR
  - Long-term expectations, 10+ years for development projects

- Minerals are located where Mother Nature put them
  - Inherent geopolitical risk difficult to predict and ever-changing

- We don’t educate our young students where things come from
  - Little understanding how difficult/risky it is to produce minerals
  - Sector is under-appreciated relative to its critical importance

1-2%of Market Value

Market Value of World Stock Market

(in $billions)	
Information Technology	15,280
Financials	13,040
Healthcare	10,400
Consumer Discretionary	10,080
Industrials	9,120
Consumer Staples	6,480
Energy	5,120
Materials	3,760
Utilities	2,320
Real Estate	2,320
Telecom Services	2,080
Total	80,000

Market Value by Company

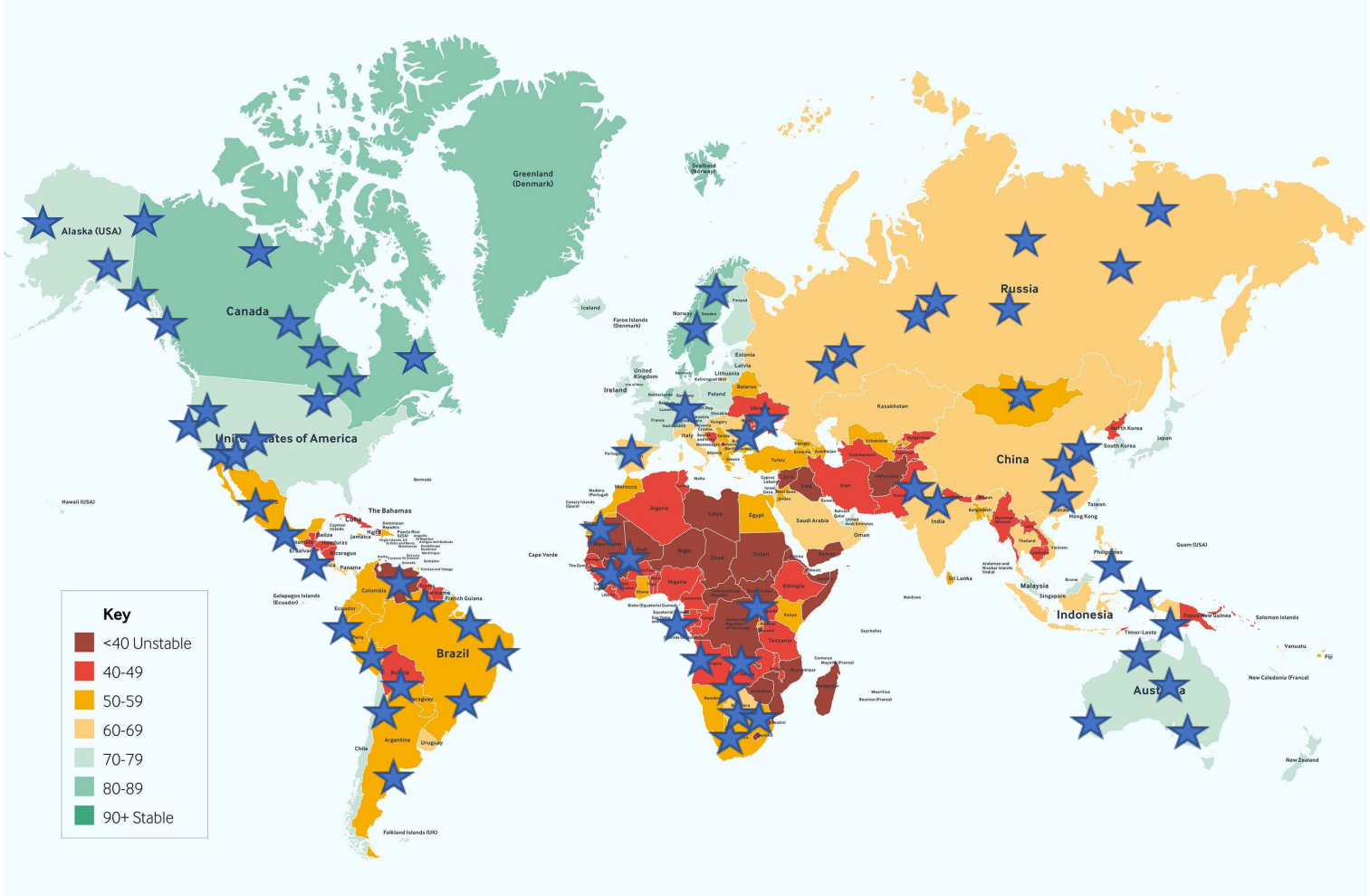
(in $billions)	
Apple	926
Amazon	778
Alphabet	766
Microsoft	750
Facebook	541
Alibaba	492
Berkshire Hathaway	499
Tencent Holdings	491
JPMorgan Chase	387
Exxon Mobil	344

Market Value Top 10 Global Mining Stocks

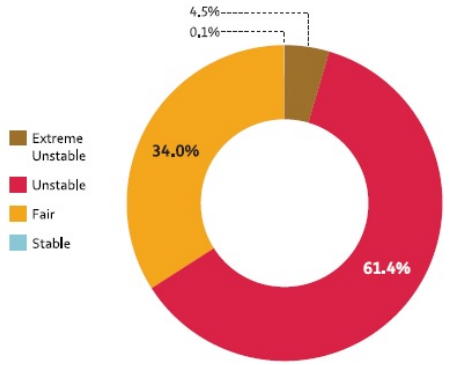
(in $billions)	
Top 10 Stocks	650

Sources: MCI World Index and Lexington Law

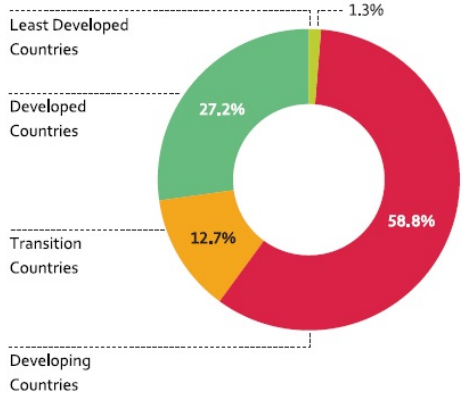
Mineral Wealth and Political Risk



Political stability of producer countries 2017

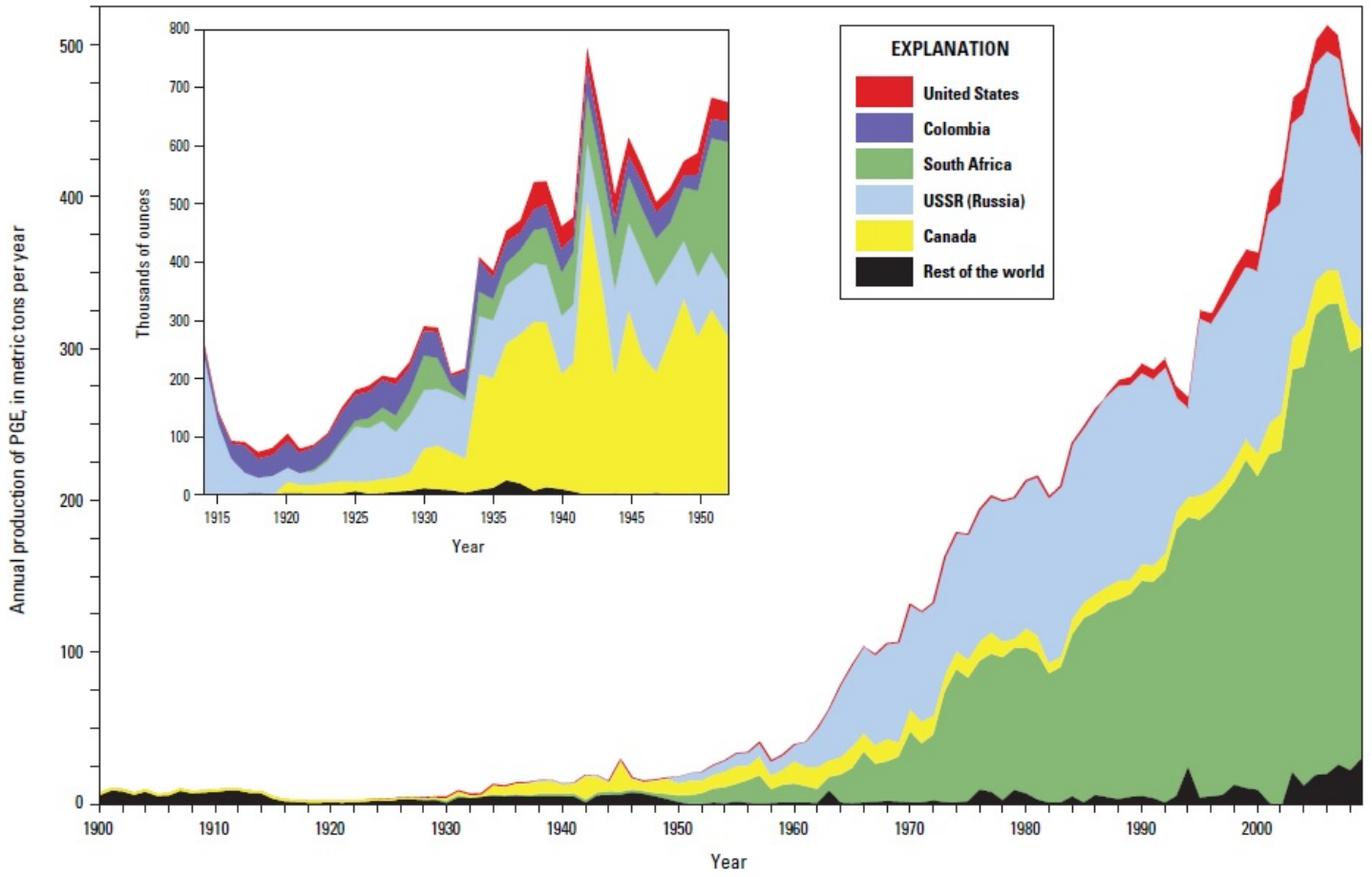


Developement status of producer countries 2017



The composite index (Country Risk Index) is a weighted average of the short-term political and economic index, long-term political and economic index and operational risk index. This allows a ranking of all countries in our emerging markets and developed countries universe. (0 = worst, 100 = best) https://www.fitchsolutions.com/events/world-worries-political-risks-2020-webinar

Where do PGMs Come From?



Source: USGS, Department of Interior

PTM: Shifting Strategy with Circumstances

PTM Market Capitalization $M(USD)

Adapting to Changing Markets

X

Maseve Platinum Mine

- Conventional platinum mine acquired, financed and built during period of strong platinum prices
- Markets shifted with change in auto sector and steep drop in platinum price
- Project execution struggled, sold for significant loss

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Waterberg Palladium Project

WATERBERG JV RESOURCES PTY LTD.

- Investment in exploration during mine build for growth and risk management
- New deposit model discovered with more favorable geology, commodity exposure and economics
- Partnership with major producer reduces risk and provides for experienced mine builders, management and finance

√

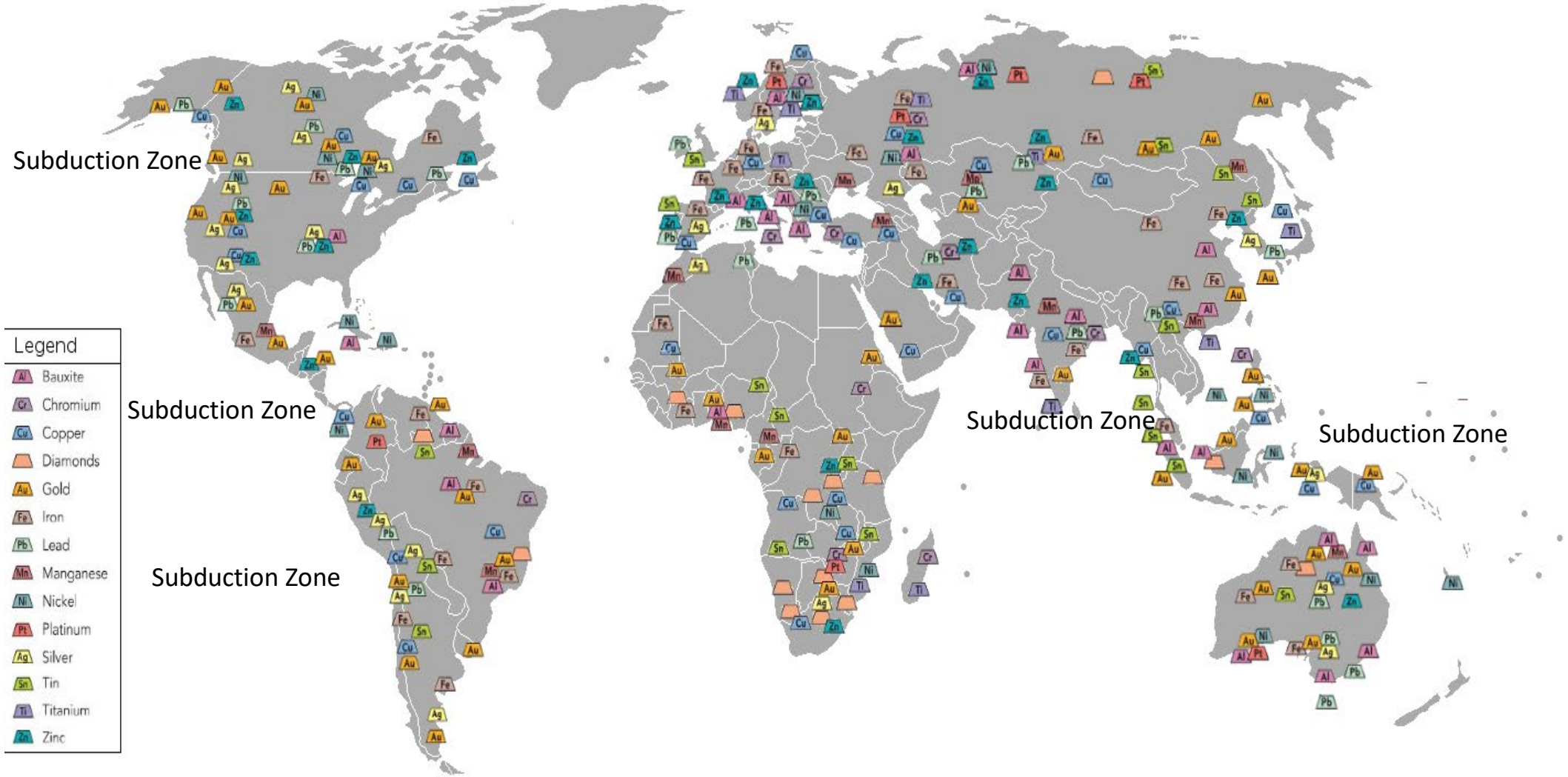
Lion Battery Technologies

Lion BATTERY TECHNOLOGIES

- Electric cars a threat to primary PGM application: catalytic converters
- Academic research being funded and supported to develop new lithium batteries using PGMs
  - Palladium-dipped carbon nanotubes
- Major mining company partnership provides early stage credibility and funding

Appendix

Major Global Mineral Deposits



Commodity Price - UP

Waterberg Basket Price has increased dramatically since the 2016 Pre-Feasibility Study (PFS)

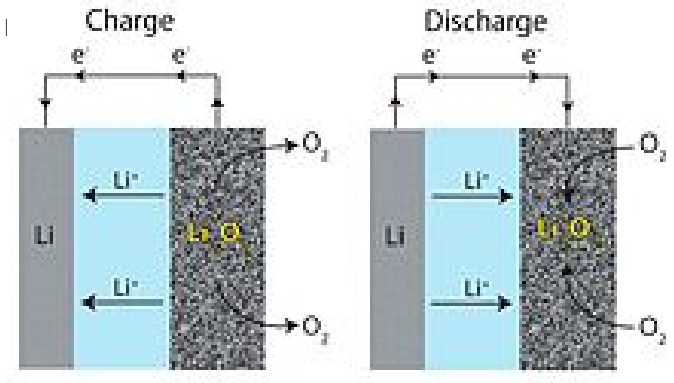
Waterberg Basket: 63% Pd, 29% Pt, 6% Au, 2% Rh
2016 PFS Banker Consensus: $800 Pd, $1,213 Pt, $1,300 Au, $1,000 Rh
September 4, 2019 Spot: $1,546 Pd, $980 Pt, $1,548 Au, $5,036 Rh

Market Development Opportunity
PGMs in Lithium Batteries

Changing the EV Threat to an Opportunity

The automotive industry is 80% + of Pd demand 30%+ of Platinum demand.

A role for PGMs in batteries would be a game changer for the PGM

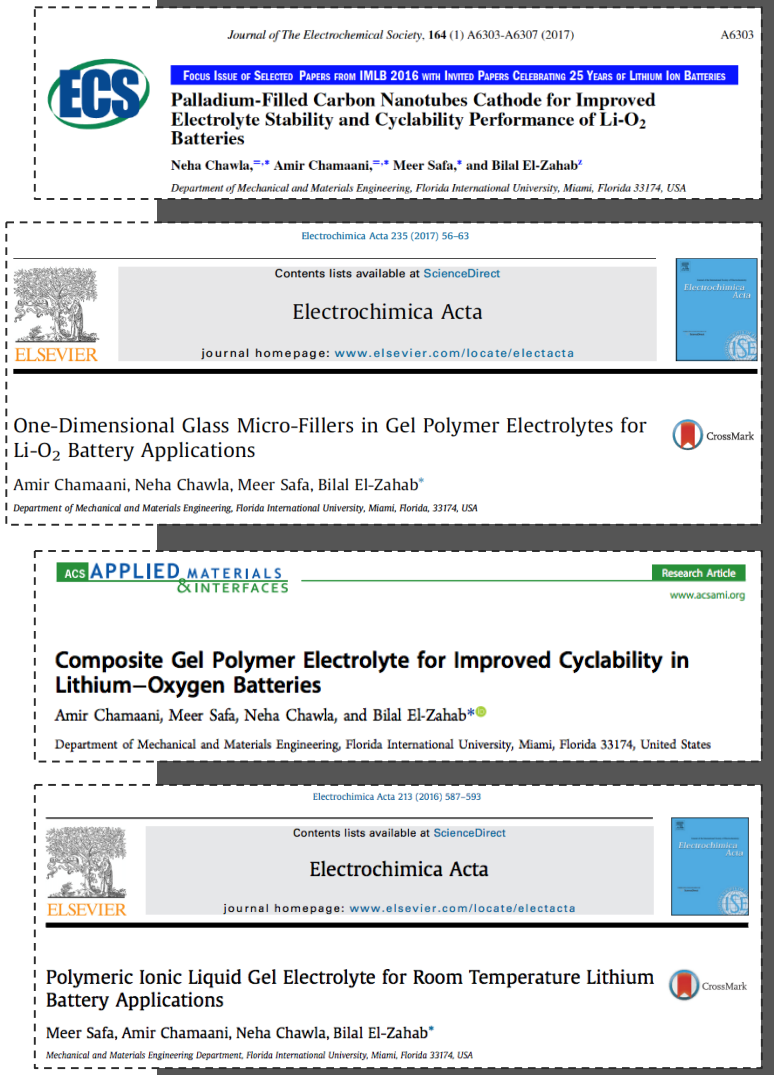


- PGMs are proven catalysts that play an important role in chemical reactions.
- FIU discovered and filed a patent on using PGM's in a particular way in a battery
- Lion Battery Technologies has signed an exclusive licence on that innovation and innovations developed together with FIU
- The research is in its early stages and may have application for Lithium Air, Lithium Sulphur and other types of Batteries

Technology Benefits

The role of PGMs is an innovative approach to batteries:

- Using Palladium/Platinum catalysts in the cathode to improve the rate capability and reduce the charge over-potential
- Using Palladium/Platinum inside Carbon for Stabilization of the electrolyte
- Custom designed electrolytes –for use in many types of Batteries
- Published Papers Demonstrate expertise in all these areas



Journal of The Electrochemical Society, 164 (1) A6303-A6307 (2017) A6303

Focus Issue of Selected Papers from IMLB 2016 with Invited Papers Celebrating 25 Years of Lithium Ion Batteries

Palladium-Filled Carbon Nanotubes Cathode for Improved Electrolyte Stability and Cyclability Performance of Li-O_2 Batteries

Neha Chawla,[=,*] Amir Chamaani,[=,*] Meer Safa,[*] and Bilal El-Zahab[z]

Department of Mechanical and Materials Engineering, Florida International University, Miami, Florida 33174, USA

Electrochimica Acta 235 (2017) 56–63

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/electacta

One-Dimensional Glass Micro-Fillers in Gel Polymer Electrolytes for Li-O_2 Battery Applications

Amir Chamaani, Neha Chawla, Meer Safa, Bilal El-Zahab*

Department of Mechanical and Materials Engineering, Florida International University, Miami, Florida, 33174, USA

ACS APPLIED MATERIALS & INTERFACES Research Article www.acsami.org

Composite Gel Polymer Electrolyte for Improved Cyclability in Lithium–Oxygen Batteries

Amir Chamaani, Meer Safa, Neha Chawla, and Bilal El-Zahab*

Department of Mechanical and Materials Engineering, Florida International University, Miami, Florida 33174, United States

Electrochimica Acta 213 (2016) 587–593

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Polymeric Ionic Liquid Gel Electrolyte for Room Temperature Lithium Battery Applications

Meer Safa, Amir Chamaani, Neha Chawla, Bilal El-Zahab*

Mechanical and Materials Engineering Department, Florida International University, Miami, Florida 33174, USA

Li-Oxygen + PGMs Potential

Comparison to Tesla Model 3 Battery Modules

	Tesla Model 3	$Li-O_2$		
		Maximum	Scenario #1	Scenario #2
Energy	75 kWh[1]	75 kWh		
Weight	371 kg[1]	43 kg	100 kg	150 kg
Cell (2170)	4,416 cells[1]	1,000 cells	2,330 cells	3,500 cells
Configuration	3.7 V/cell	2.7 V/cell	2.7 V/cell	2.7 V/cell
Chemistry	NCA	$Li-O_2$		
Specific energy / cell	202 Wh/kg	1,700 Wh/kg	750 Wh/kg	500 Wh/kg
Cost per kWh	$150 per kWh[2]	$21.2 per kWh	$50 per kWh	$75 per kWh
Cost per kg	$31 per kg	$37 per kg	$37 per kg	$37 per kg
Cost of 75kWh module	$7,000 – 11,250[2,3]	$1,590	$3,760	$5,590
Grams of Pd	$0	12 g	30 g	44 g
Cost of Pd	$0	$600	$1,500	$2,200
% Cost of Pd	0%	37.7%		
Cycle life	500+ cycles	500 cycles (target)	500 cycles (target)	500 cycles (target)

[1] https://evannex.com/blogs/news/tesla-s-battery-pack-is-both-mysterious-and-alluring-work-in-progress
[2] https://www.bloomberg.com/news/articles/2019-06-05/gm-plans-to-sell-electric-cars-to-joe-sixpack-and-make-money
[3] https://interestingengineering.com/tesla-puts-price-on-model-3-battery-module-replacement-around-5000-7000