



Instantaneous Hydrogen Generation for Soldier Power On Demand

**Anit Giri, AJ Roberts, Joe Marsico, Chad Hornbuckle, Scott
Grendahl and Kris Darling**



What is the amount of ARL AI powder required to power a tactical wheeled vehicle?

To Run a ZH2 (Modified Chevy Colorado) 140 Miles

- Requires 4.2 kg H₂
 - 38 kg of ARL AI + water



Self-Pressurizing
In-Field
H₂ Production



ARL AI Increases Mission Range with Enhanced Fuel Volume, Cost, & Logistics Efficiency



Introduction



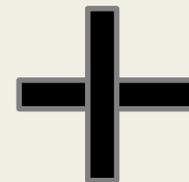
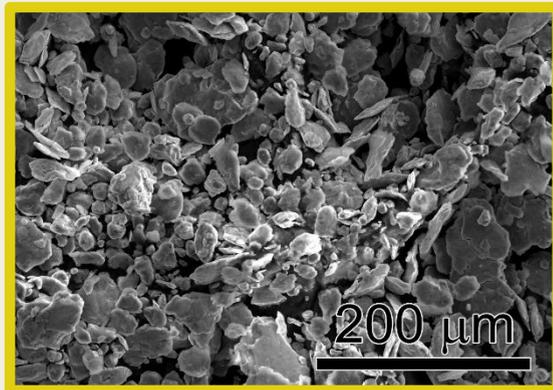
NEW DISCOVERY: NANO-GALVANIC ALUMINUM BASED POWDER



Hydrogen Balloon

New Powder Prototype Spontaneously Splits Water to Form Hydrogen

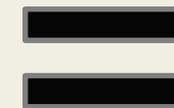
Nano-Galvanic Powder



H₂O

Sport Drinks

Urine



Energy



Hydrogen Gas Feeds Fuel Cell for Individual Soldier/Vehicle Power Generation on Demand



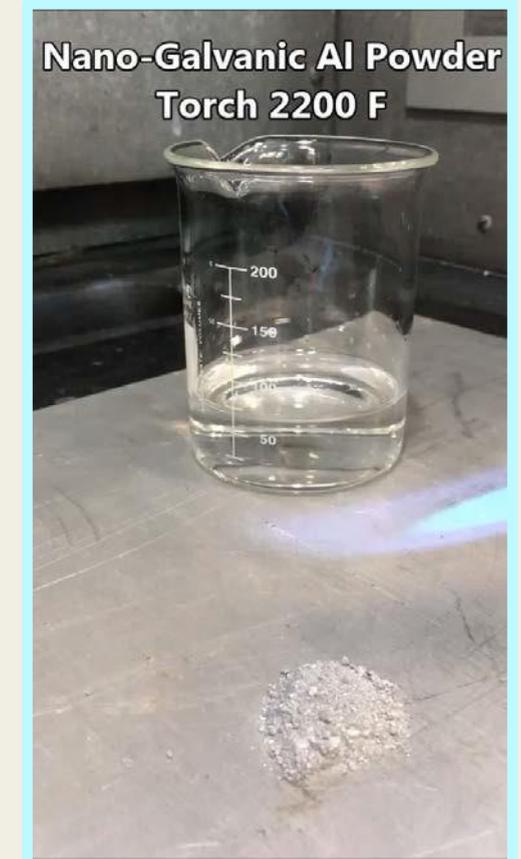
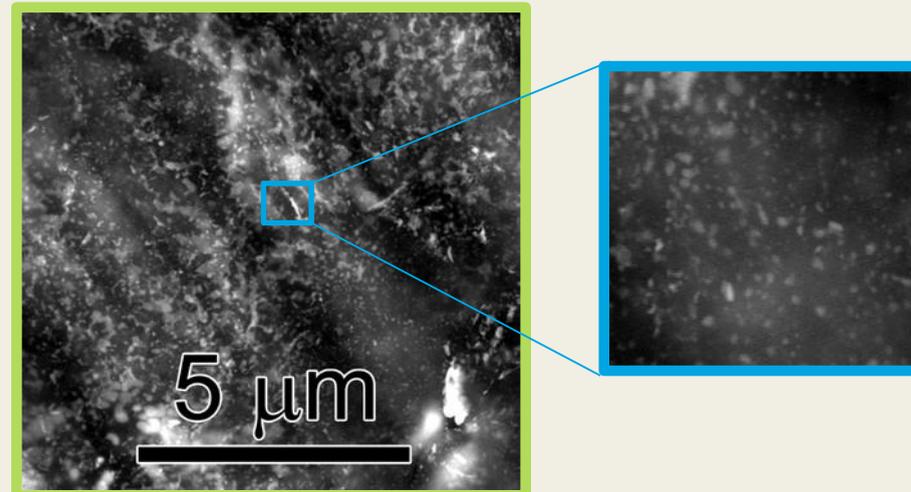
Making H₂ by Reaction with Al is Well Known

So What is the Difference ????

Disruptive Discovery

- No acid, base, catalyst required
- No toxic by-products
- Fastest reaction rate
- Easily scalable
- Mechanically strong
- 3D printable
 - Self-cannibalizing Robots/Drones

- Novel Nano-Galvanic Mechanism

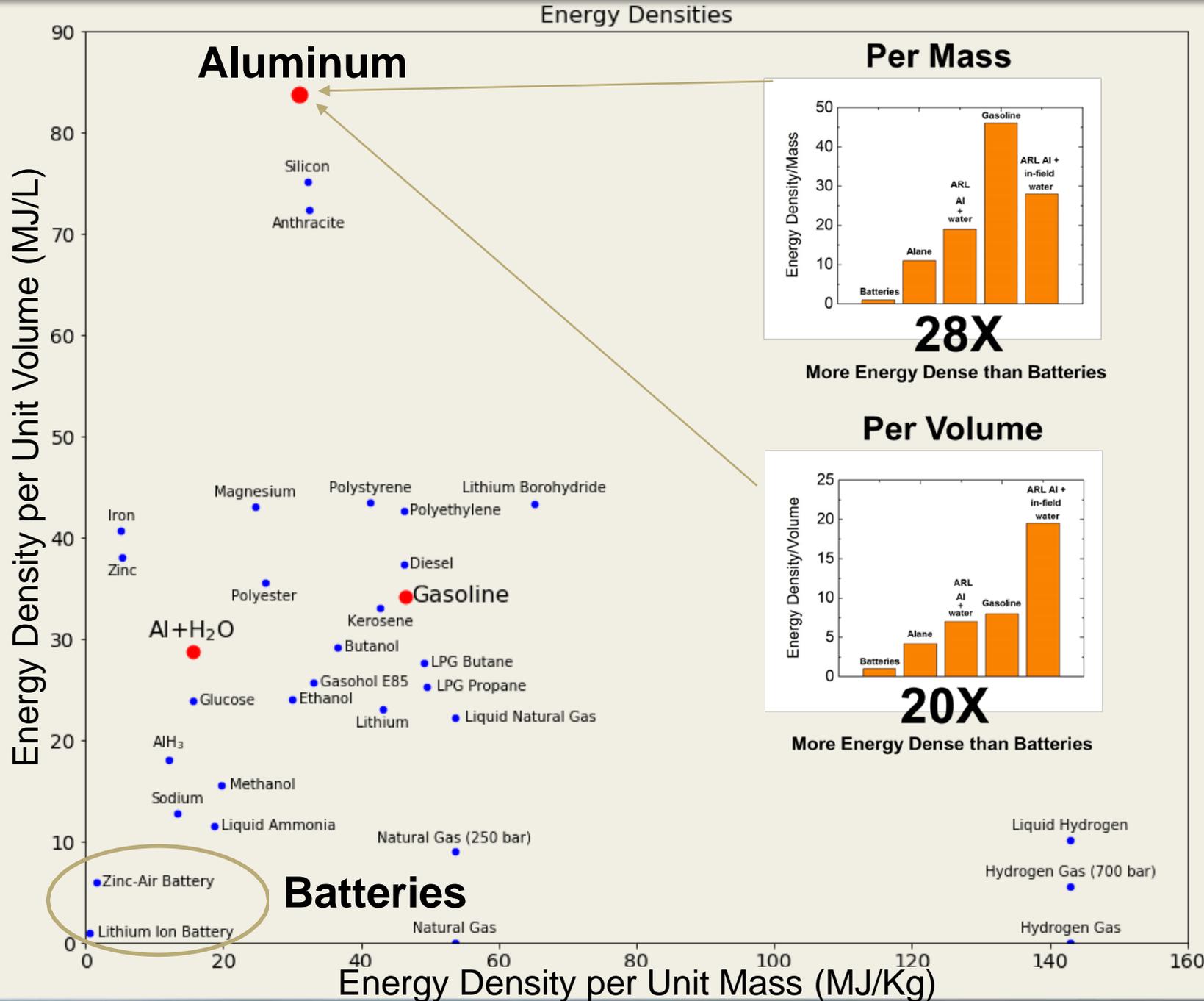


Stable Against Incendiary Attack

Provisional Patent Granted "Aluminum Based Nano-Galvanic Alloys for H₂ Production"



Aluminum as Energy Source

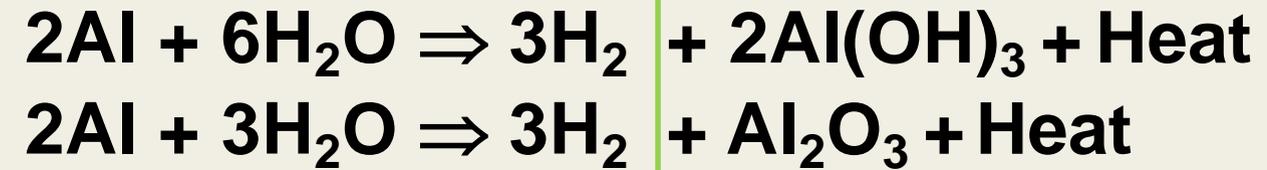


Energy density of this Al Block (2 lbs.) \cong 60 lbs. of batteries



What is the chemistry, is it safe, and is it scalable? By-products?

By-products



- **100% H₂ yield** in ~3 min. and 75% in ~ 1 min
- **Non-toxic** by-products
- **Easily scalable**
- **Mechanically Strong**
- **3D printable**
- **Self-cannibalizing** robots/drones, self pressurization (in-field welding, explosive/propulsion/actuation), structural material



Aluminum as Energy Source

ARL



Structurally Stable



Soldiers carrying such Al tablets in pockets can generate H_2 in-field

Solid Tablet of Nano-Galvanic Al 96% Theoretical Density



H_2 Production



3X Faster



Logistical Impact of P&E and Capability



- In Afghanistan/Iraq, cost of JP-8 was \$400-\$1000/gallon
- Can be easily dropped into remote locations as compared to JP8
- Less batteries = less weight to carry for longer missions without resupply
- Water from almost any source can be used for in-field hydrogen production
- On demand power and energy generation at the point of need for self-sufficiency and reduced logistics resupply requirements



Lake, Pond, River, Stream and Swamp



Condensation (natural or AC units)



Precipitation Rain and Snow

Generate Safe Power from Various Water Sources



Logistical Impact of P&E and Capability

ARL



The amount of fluid one spits (1-2 ml) is capable of generating 1 L of hydrogen



“Black Water Pond” at Kandahar airfield



30,000 people produce 5.4 million gallons of black water (sewage water) per week or 30 million gallons per month. **100 Billion Liters of Hydrogen per Month**

Huge Potential Energy Source “500 giga watt hour” (500,000 U.S homes/month)

Scavenged Aluminum Alloy



- Scavenged Al cans/battlefield scrap can be used for production of nano-galvanic Al at the point of need
- JP8 can not be manufactured in the field



Worldwide Interest



ARL Synchronized Communication Results
 DISCOVER ▶ INNOVATE ▶ TRANSITION

Materials for Power & Energy

A strategic, integrated communication approach to share information about U.S. Army Research Laboratory research that involves a new nanomaterial that when combined with urine can generate power and give military members easier access to energy.

52 MILLION+ Total U.S. Reach

STRATEGIC Innovation Summit 2017
 ENGAGEMENT



f 100 likes
 72% male
 5,402 from US
 7,812 speak English

t 21,687 tweet impressions
 15% female
 13,600 from US
 47% science news interest

6.6M+ views 45M+ readers 164K listeners



Top 10 Media Hits

Fox News	24804807
Mic	4817458
The Inquisitr News	3684425
Phys.org	2979837
Nasdaq.com	2965321
Smithsonian	2956885
The United States Army	1732131
WGN-TV (IL)	836434
FOX2now.com (MO)	604536
MVFOX8.com (NC)	561082



This discovery has made headlines bringing attention from multiple countries, industrial partners and universities through numerous mass media outlet interviews (>52M Hits)



Conclusions



- Disruptive Discovery: Fastest H₂ Generation
 - Nano-galvanic powder + any liquid that contains water
- On Demand In-Field Power Generation
- Potential to Dramatically Change how the Army/DoD Mission is Conducted