Advances in R&D and Production of Thermal Batteries

The Future of Munitions Batteries Workshop

Ofer Raz

Power Sources Department
Rafael LTD.
POB 2250, Haifa, Israel, 3102102
Manor - Core Capabilities

MOTORS
- Solid Rocket, Air Breathing
- Space,

Warheads & Explosives

Fuze, S&A and Pyrotechnics

Thermal batteries

Metal Technology

Radomes structures and Missile canister

MEMS

Optical Components

Proprietary of Rafael – Advanced Defense Systems Ltd
Thermal batteries
Power Sources Department

- Operate since 1985
- Supporting Rafael, Israeli and international leading defense players
Power Sources Department

- 50 models available
- High quality manufacturing
- Activation: electrical, mechanical, acceleration, air pressure
- New designs according to customer's specification

Thermal Battery Applications
Thermal battery pros and cons

**Pros**
- High power density
- Long shelf life
- Maintenance free
- Reliability
- High tolerance to environmental conditions
- Custom made

**Cons**
- Cost
- Thermal footprint
- Short operating life
Modern Thermal Battery

- High Power
- Less Volume/Mass
- Flexible Geometry
Challenges

- Rapid development
- Cost
- Initiation
- High production capacity
- High power
- Small volume/mass

R&D
R&D focus

NEW THERMAL BATTERY

HIGH POWER DENSITY

MODELING & SIMULATION

AUTOMATION/ LOWER COSTS

ADVANCED MATERIALS
Modeling & Simulation

- Greatly reduced development costs
- Better product performance and optimization
- Early discovery of possible weak design points
- Components geometry
- Evaluation of possible impacts of new concepts
Thin film technology

- Increased power density
- Smaller volume/mass
- Reduction of thermal footprint
- Shorter initiation
- Potential for increased production volume and cost reduction
- Flexible geometry
Production of Thin Film Batteries

- Small scale production for model battery is underway
- Scale up for a large capacity production
- Developing of non cylindrical battery
New thermal battery materials

- **Insulation**
  - Improved performance
  - Reduction of thermal footprint

- **Cathode**
  - Increased Voltage & Capacity
  - Better Thermal Stability
  - Wider operation window

- **Separator**
  - Lower resistance
  - Wider operation window
Automation

- Quality Improvement
- Lower production costs
- Increased capacity
- Standardization
Questions ?