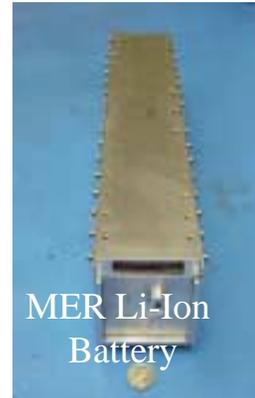


Batteries for Planetary Landers & Rovers



SOA Capability

Chemistry: Li Ion with ternary EC:DMC:DEC

Specific Energy at -20°C : 80 Wh/kg

Rate Capability : $< \text{C}/5$

Operational Life : 3 years

Technology Needs

Low Temperature Operation (-60 to $+60^{\circ}\text{C}$)

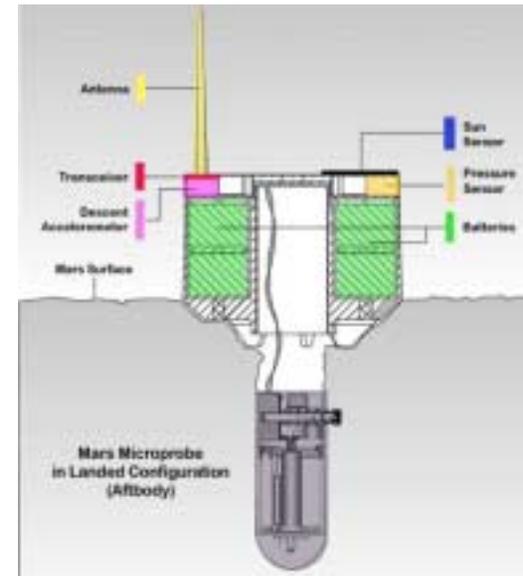
High Specific Energy (> 100 Wh/kg)

High Rate Capability (> 2 C)

Long Cycle Life (> 1000 cycles)

Long Operational life: (> 5 years)

Batteries for Planetary Microprobes



SOA Capability

Chemistry : Li-SOCl₂ and Li-SO₂
Operating Temp: -60°C to 70°C
Voltage Delay (minutes at low temperatures)
Specific Energy at -60°C: < 100 Wh/kg
Low Rate Capability : < C/50
Shelf Life : 5 years

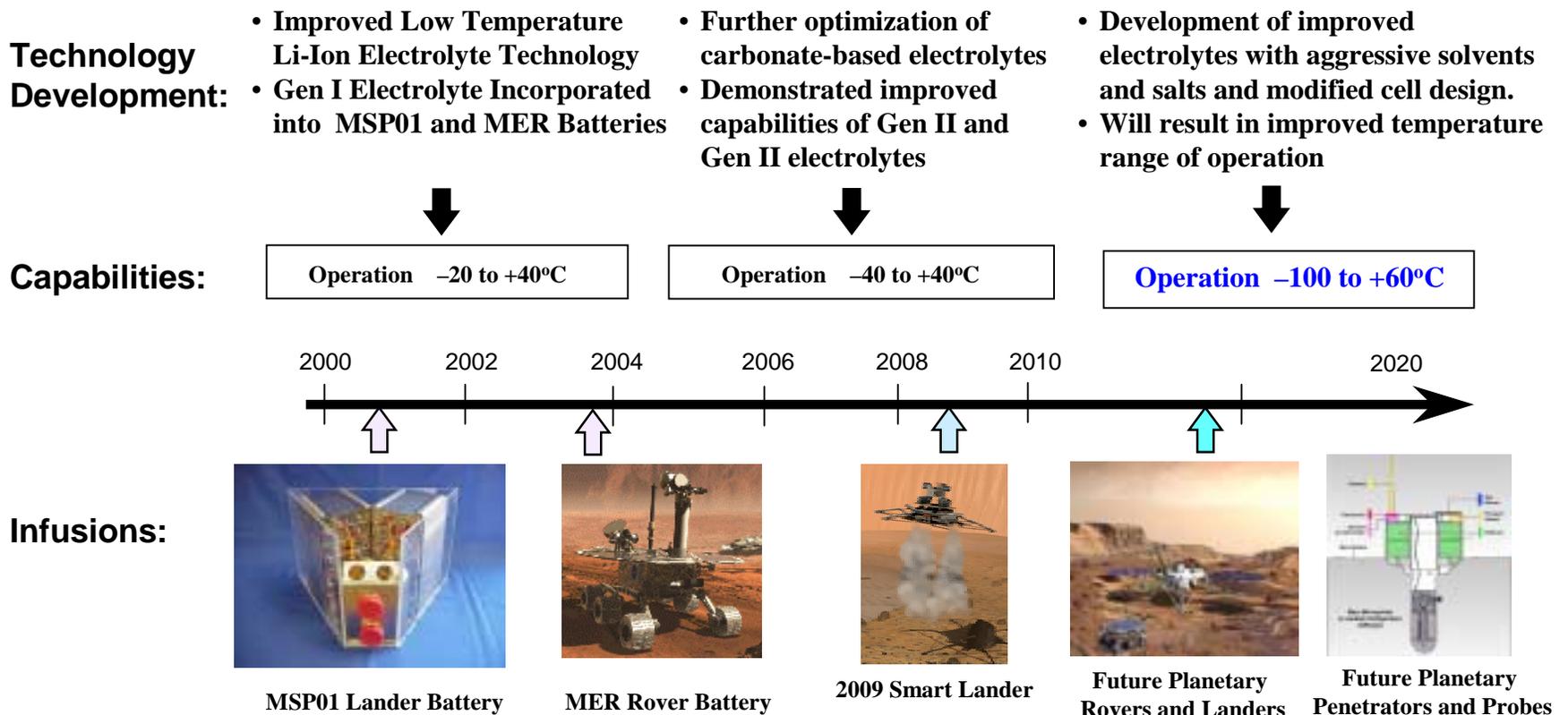
Technology Needs

Ultra Low Temperature Operation (-100 to -80°C)
No significant Voltage delay (< seconds)
High Impact Shock Capability (> 20,000 g)
High Specific Energy (200 Wh/kg)
High Rate Capability
Long Shelf life: (5-10 years)

Development of Advanced Lithium Cells and Batteries

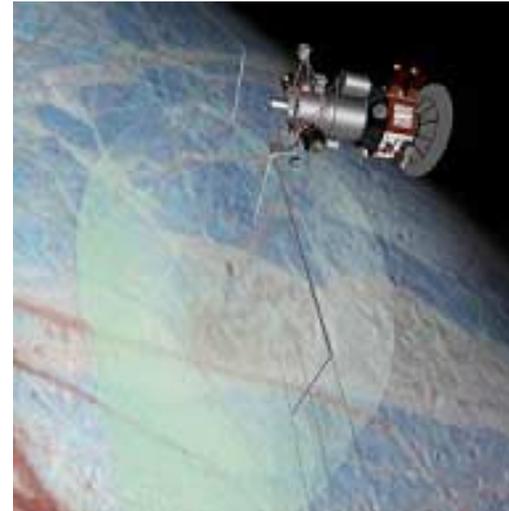
Vision and Goal for Advanced Rechargeable Li-based Systems

Goal: To develop rechargeable lithium-based cells for future NASA applications which are capable of operation over a large temperature range, especially at low temperatures (-100° to +40°C).



Batteries for Jovian Missions

(Orbiters/Landers/Probes)



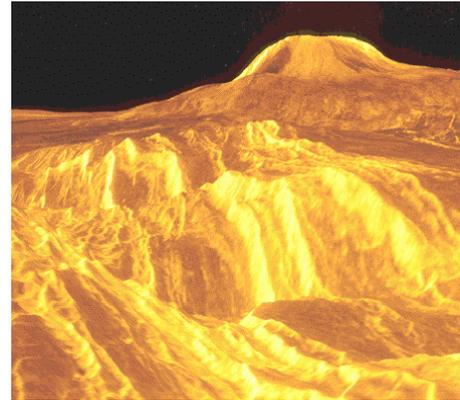
SOA Capability

Chemistry: Super Ni-Cd
Radiation tolerance: (10-20 Mrad)
Specific Energy : 30 Wh/kg
Energy Density : 100 Wh/l
Calendar Life: 10 years

Technology Needs

Tolerance to high radiations (10-20 Mrad)
Long Calendar life (10-15 years)
High Specific Energy (>100 Wh/kg)
High Energy Density (> 200 Wh/l)

Batteries for Inner Planetary Missions (/Probes)



SOA Capability

Chemistry:

Na- Sulfur (300-400°C)

Na- MCl_2 (250-450°C)

Li- FeS_2 (300—400°C)

Specific Energy : 100 Wh/kg

Tolerance to shock/vibration: Low to medium

Safety and Reliability : Poor to moderate

Technology Needs

High temperature Operation : Up to 500°C

Specific Energy : 100 Wh/kg

Tolerance to shock/vibration: High

Safety and Reliability : High