

Application Notes: Marine

Case study:

At OXIS we are working on a grant funded collaborative research project in collaboration with Steatite, National Oceanography Centre and MSubs. The project aims to create a custom made pressure tolerant battery pack for submarine applications, to overcome weight issues associated with batteries in a pressure vessel.

Autonomous Underwater vehicles are energy limited; this restricts their operational envelope, so speeds are usually low (2-4 knots) and endurance is restricted. By significantly increasing the energy available within the vehicle, the operational capacity can be expanded thereby increasing the speed and range. As vehicles go deeper, the pressure vessels become excessively heavy and expensive. This project directly relates to endurance at higher speed, and specifically the improved energy density, for maritime autonomous operations and low power demand systems providing significant vessel endurance and longer mission durations. The benefit of creating a lighter pressure tolerant Li-S pack will allow for more sensing equipment to be installed, providing research institutions or end users with the ability to collect more valuable data.

The graph below shows the comparison of the different iterations / generations of the OXIS Li-S technology with the state-of-the-art Li-Polymer cell technology developed by Kokam, currently being used for MAS applications. The improvement on the gravimetric energy density of OXIS cells from generation 1 and 2 cells to the generation 3 at different test conditions is illustrated. The comparison of OXIS Gen 3 cells and the Li-Polymer cells also shows an improvement of around 90% at cell and battery level at both ambient and high pressure / low temperature conditions.



The key benefits of the Li-S technology for the marine sector are as follows:

- **Lightweight & Naturally Buoyant** - significantly improved buoyant specific energy compared to Li-Polymer cells, reducing or eliminating the need for highly expensive buoyancy material in the vessel; increased endurance = ease of installation and reduced costs.
- **Pressure & Temperature Tolerant** - operate under the combined pressure of 45 MPa (450 Bars / 4500 meters under water), and at the temperature of 4°C, within the required specification for marine underwater applications.
- **High Gravimetric Energy Density** - 5 times the theoretical maximum specific energy of Li-ion cells, energy densities of 400Wh/Kg achieved during 2016.
- **Cost Competitive** - lower cost of materials within the cells and the highest energy density.

