Passive Propagation Resistance: Improved Thermal Insulation for Battery Modules

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Thermal runaway in battery modules poses a significant risk to safety and performance, making it a critical issue in the development of energy storage systems. As battery modules are increasingly used in various applications, from electric vehicles to battery energy storage systems, the need for effective passive propagation resistance, and ideally suppression, becomes paramount. Challenges include ensuring that thermal runaway, once initiated, does not propagate to adjacent cells thereby mitigating the risk of catastrophic failure and enhancing the overall safety and reliability of battery systems.

CHALLENGE: Insulate Between Cells To Prevent Thermal Runaway Propagation

BESS Thermal Insulation:
Key Considerations

- **Thermal Performance:** Ensure the insulating materials provide sufficient thermal resistance to contain thermal runaway and prevent heat from spreading to adjacent cells.
- **Ease of Installation:** Choose materials that are easy to convert and install, ensuring practical application in various settings.
- **Particulation:** Minimize particulation to avoid contamination and maintain the cleanliness of the battery modules.
- **Compression Tolerance:** Ensure the thermal barrier maintains structural integrity under high stress cyclic compression, providing persistent reliable insulation even at end-of-life pressure conditions.
- **Safety and Reliability:** Balance all factors to develop a robust and efficient thermal management strategy that enhances the overall safety and reliability of the BESS modules.

Figure 1: GORE Battery Insulation

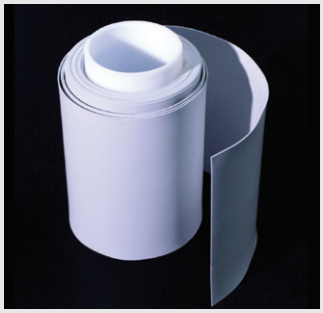
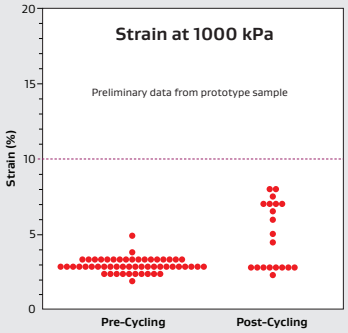


Figure 2: GORE Battery Insulation Compression Under High Stress and After Cyclic Loading Up to 2000 kPa



GORE Battery Insulation Features

CASE STUDY: Suppression of Thermal Runaway Propagation in a BESS Module Using GORE Battery Insulation Technology

A BESS module thermal runaway simulation test compares the temperature versus thicker layers of alternative resistance performance of a layer of GORE Battery Insulation versus alternative industry solutions cork and silicone foam, with data shown in Figure 3.

Figure 3: BESS Thermal Testing Data

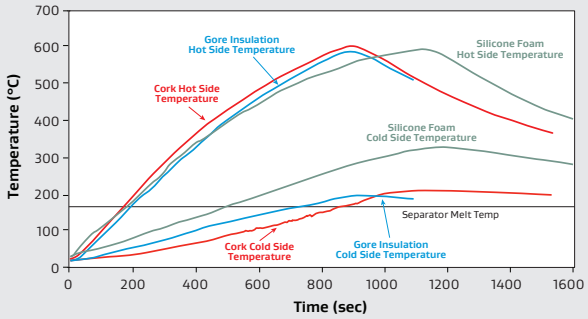


Figure 4 below shows the test setup: a heater block is placed centrally between "dummy" cells, with a thermal barrier in-between and temperature data collected on each side of the barrier layer. A layer of GORE Battery Insulation technology is shown to significantly outperform 3X thicker alternative solutions in suppressing temperature rise.

Figure 5 shows a full-scale BESS test module post-test , highlighting that a layer of Gore thermal insulation effectively isolated thermal damage to one individual cell, preventing thermal runaway propagation to neighboring cells.

Figure 4: BESS Thermal Testing Apparatus

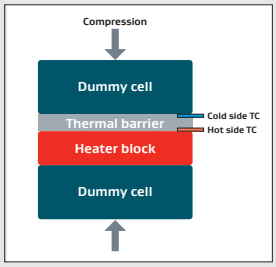


Figure 5: BESS Module (Our Next Energy, Inc.) Post-Thermal Runaway Test using GORE Battery Insulation

Conclusions

Gore's developmental battery insulation technology has demonstrated its effectiveness as a significant barrier to thermal runaway propagation in a BESS module test, outperforming 3X thicker alternative insulation products, supporting higher volumetric energy density. This technology is available in an easy-to-install, non-particulating form that resists compression, ensuring consistent thermal barrier performance throughout the battery module's lifetime.

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Together, improving life