

7:05 Power Electronics for Space Applications

Trends in 18650 Lithium-Ion Battery Cell Safety for Spacecraft Applications

Highly popular due to their high energy density lithium-ion battery cells have increased in energy density approximately 2.5 times since their commercial debut in 1991. As a result, the hazard severity of a sudden inadvertent release of stored energy has greatly increased. The high energy density of lithium-ion battery cells coupled with the flammable toxic electrolytes they contain and unique failure modes can lead to a potentially catastrophic thermal runaway. This can result in spewing flames even while setting on a shelf unused. The metal oxide cathodes in lithium-ion battery cells can release their oxygen into the cells when they overheat. There is enough oxygen contained in the metal oxide cathodes to combust up to 20% of the electrolytes in the cells without any outside oxygen sources. These cells can therefore be viewed as miniature rocket motors capable of venting a considerable blow-torch type flame and up to 2.5 liters of hot flammable toxic gases per cell. This presents special challenges for spaceflight safety. In this paper we will examine roots causes of 18650 lithium-ion battery cell failures and how to best mitigate them at the cell and battery assembly levels. We will also look at some promising future trends that could yield both much greater stored energy and safety.