Experimental and modeling study of thermal runaway propagation of 18650 form factor lithium-ion battery array

Dong Zeng, Lauren Gagnon, Yi Wang

FM Global, Research Division

Thermal runaway propagation (TRP) is a major hazard of Li-ion battery (LIB) modules. This study investigates thermal runaway propagation of LIB modules made of 18650 form-factor LIB cells. This type of LIB cell is widely used in data center battery backup units and electric vehicles. TRP experiments were conducted with two-cell or nine-cell arrays for two types of LIBs. The cathode materials for the two battery types are lithium cobalt oxide ($LiCoO_2$ or LCO) and lithium iron phosphate ($LiFePO_4$ or LFP). Both battery types have graphite as their anode and are tested at a 100% state-of-charge. The TRP rates across the LCO cell arrays are significantly faster than across the LFP cell arrays. In addition to the TRP experiment, heat transfer between copper slug with the same shape as an 18650 LIB cell was also experimentally investigated to support heat transfer modeling. The TRP modeling of an 18650 cell array includes a LIB cell thermal runaway model and a heat transfer model between cells. A previous study developed a lumped thermal runaway model for a single 18650 LIB. A network TRP model was developed by modeling each cell using the lumped thermal runaway model and heat transfer among cells in a network fashion. The model successfully predicts the TRP rate in both sizes of LCO and LFP arrays.