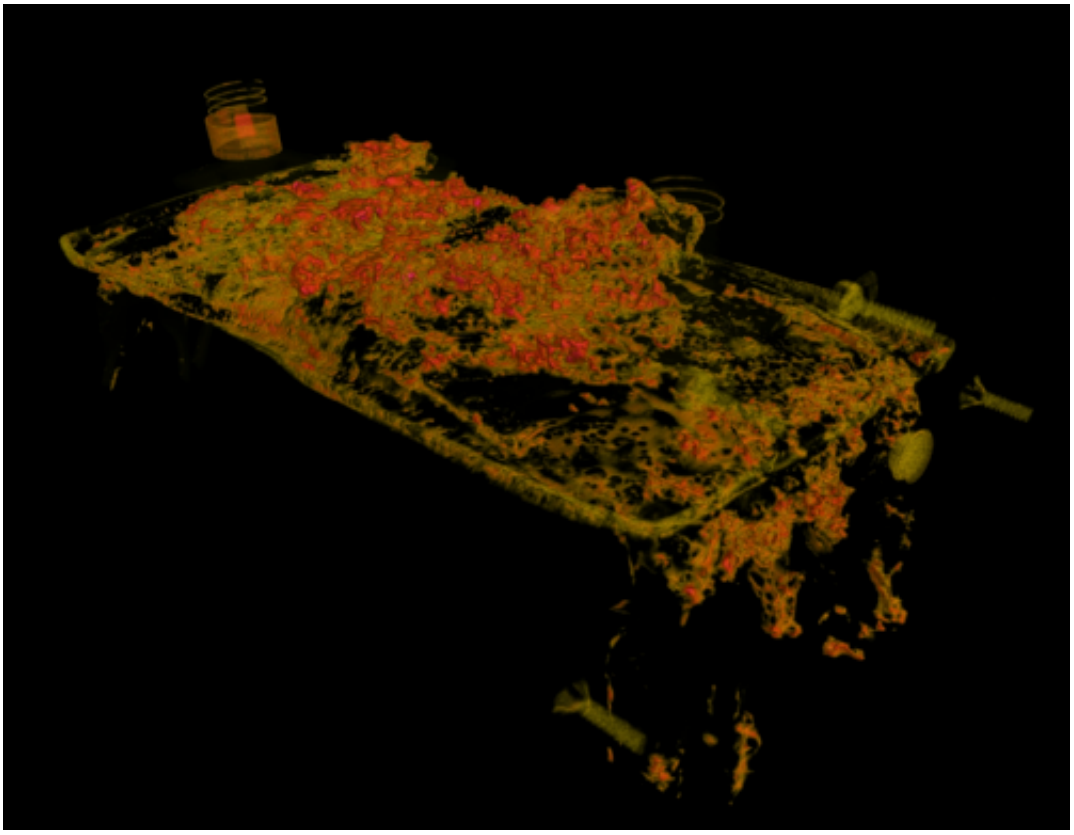
NIST helps NTSB solve 787 battery fire puzzle

December 12 2014, by Daniel Hussey



In NIST's neutron CT scans, the battery cells were rotated in the neutron beam, and radiographs were acquired at several angles. The data were reconstructed into 3D volumetric images. This image was made from data on cell number 5, one of two that failed. Areas of high neutron attenuation are shown in orange, red, or pink (pink is the highest). The electrical insulation between the terminals and the casing has been badly damaged by the fire, and there is no evidence of a lithium deposit connecting the terminals to the battery casing.

In January, 2013, an auxiliary power unit battery aboard a Japan Airlines Boeing 787 "Dreamliner" experienced a "thermal runaway event" resulting in fire and heavy smoke at the front of the battery case. At the time, the airplane was parked at a gate at Logan International Airport in Boston.

Nine days later, a similar event occurred in-flight on an All Nippon Airways Boeing 787 resulting in an emergency landing in Takamatsu, Japan. That same day, the FAA issued an emergency Airworthiness Directive to address a potential battery fire risk. The entire Boeing 787 fleet was grounded worldwide until an engineering solution was in place (about March 12, 2013).

Earlier this month, the National Transportation Safety Board (NTSB) released its Aircraft Incident Report on the subject, concluding that the fire was probably caused by an internal short circuit within a cell of the lithium-ion battery. To reach that conclusion, the agency relied in part on neutron imaging of the battery cell components conducted at NIST, which convincingly ruled out one alternative explanation.

Two distinct flames had erupted at the electrical connector on the front of the battery case, presumably as the result of heat from a short circuit. But was it an internal or external short? If external, there should be signs that lithium – a good electrical conductor – had escaped the cell and made contact with the cell casing.

The NTSB requested that PML staff scan the battery cell headers with neutron computed tomography (analogous to a medical CT scan, but using neutrons instead of X-rays). Although it is the third lightest element, lithium is a strong neutron absorber, and thus has a distinctive, large, signature in neutron CT.

The CT data, analyzed by NTSB staff, indicated no evidence of external

lithium-containing deposits between the cell terminals and the external cell casing. (See figure, top right.) That determination was included as an addendum to the agency report.

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