



**BLACK DIAMOND**  
**STRUCTURES™** Austin , Texas , USA

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# **NANO TECHNOLOGY SOLUTIONS**

## **FOR SULPHATION AND CORROSION IN LEAD ACID BATTERY**

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MOHAMED SHARIF | ILZDA - EDUMET WEBINAR ON LEAD BATTERY

# MOLECULAR REBAR®: SOLUTION TO LEAD ACID BATTERY PROBLEMS

## Positive plate corrosion

- Corrosion is unavoidable and fundamentally required for Lead-acid battery function, Controlling it has always been a challenge
- Made more difficult by higher operational temperatures in the engine compartment
- Major problem in Automotive , UPS and E Rickshaw Flat batteries

## Negative plate sulphation

- Evolves from idle condition of negative plates such as long storage, deficit charging and non-uniform active material utilization
- Sulfated surface having large insulative Sulphate crystals causes capacity loss
- Major problem in deep cycle application such as E-rickshaw and Solar; unable to charge quick leads to sulphation

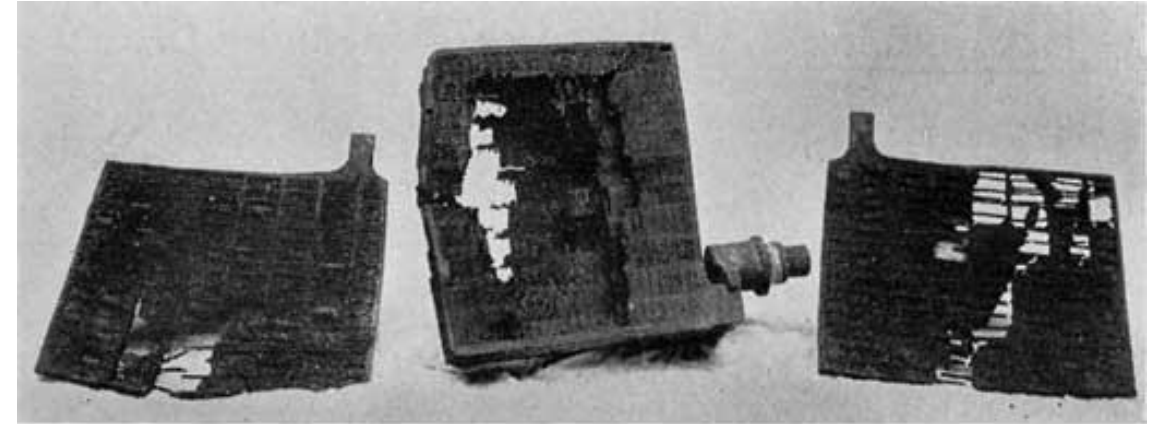
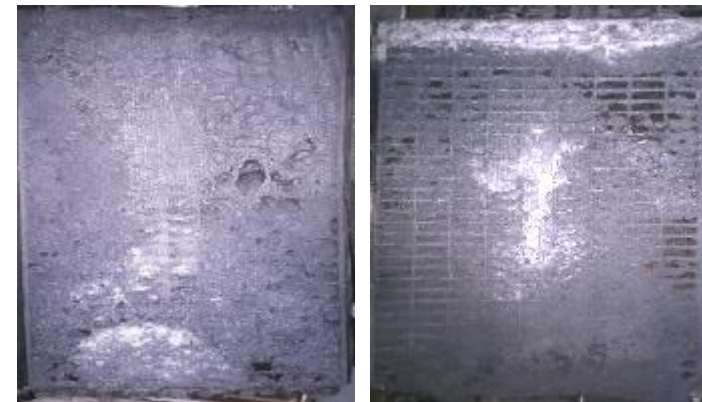


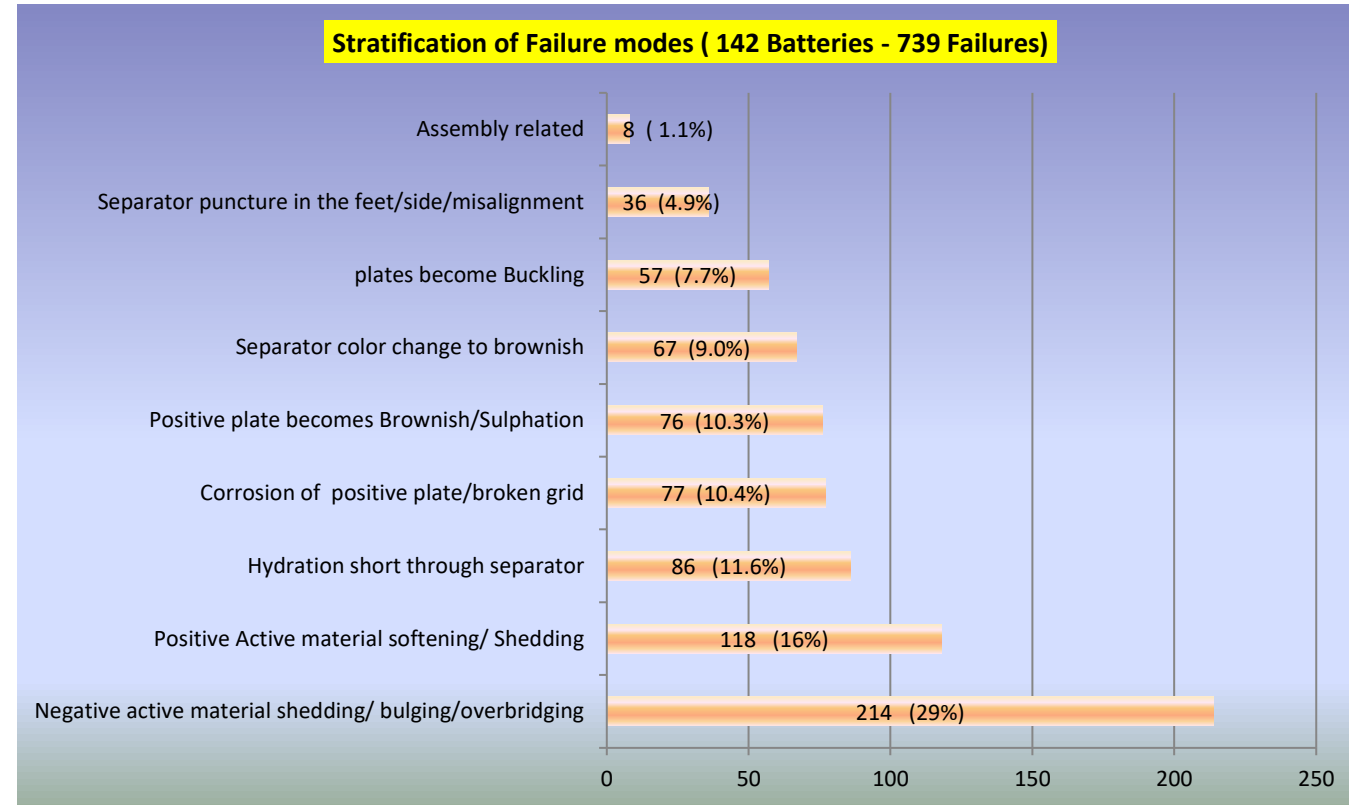
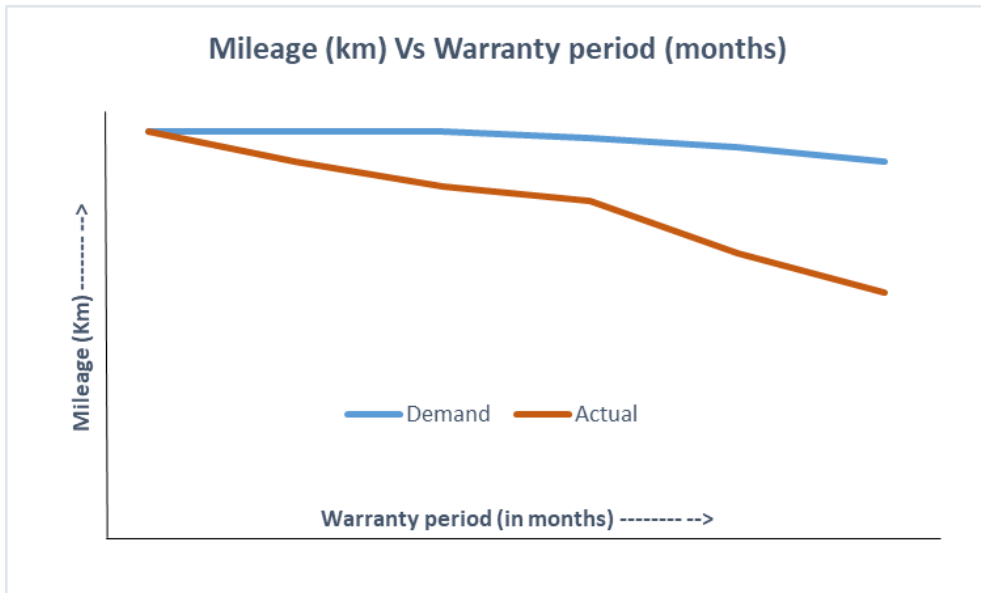
Fig. 210. Disintegrated Positives

A Witte. *The Automobile Storage Battery; Its Care and Repair*. Ford Model A Manual 1922



Negative plates of E-rickshaw after life cycle test

# NEGATIVE PLATE SULPHATION : E-RICKSHAW PERFORMANCE GAP

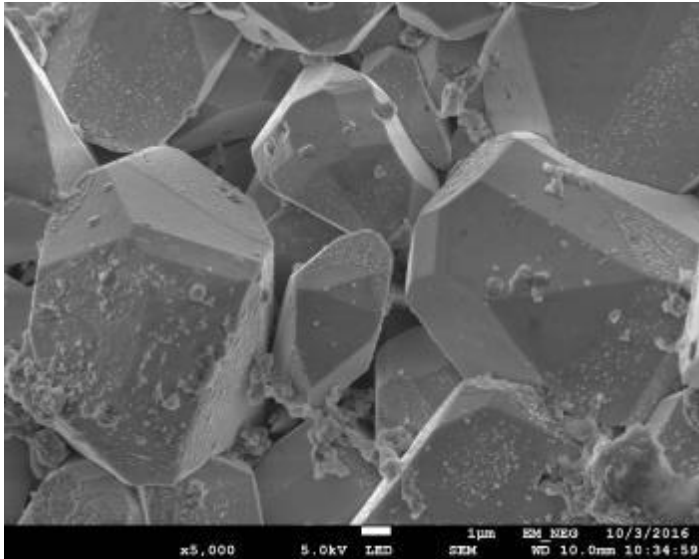
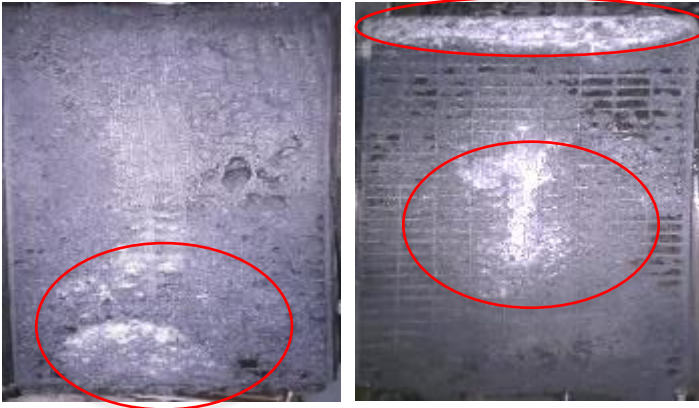


**Negative active material Sulphation and Bulging believed to be the trigger of all other failure modes occurring in an E-rickshaw battery**

Source : Independent Study conducted by BDS

# MOLECULAR REBAR® IMPACT ON E-RICKSHAW BATTERY PERFORMANCE

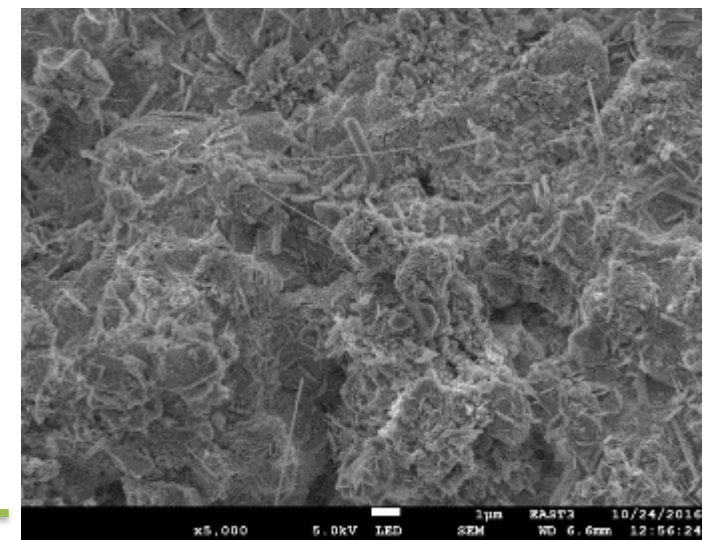
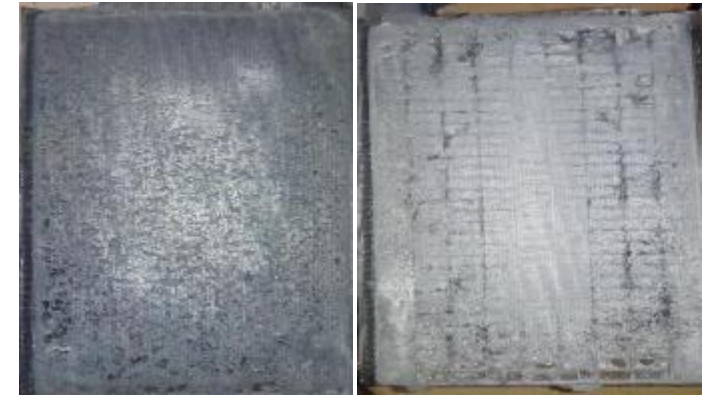
Control Negative



- Non-uniform material utilization
- Material soft and puffing/falling out
- **Heavily sulfated surface**
- **Large insulative Sulphate crystals**

- Shiny surface, plate still usable
- No sulfate present on surface
- **Smaller and uniformly sized crystals**
- **Molecular Rebar®** increases the utilization of the Pb already in the plates

Molecular Rebar® Negative



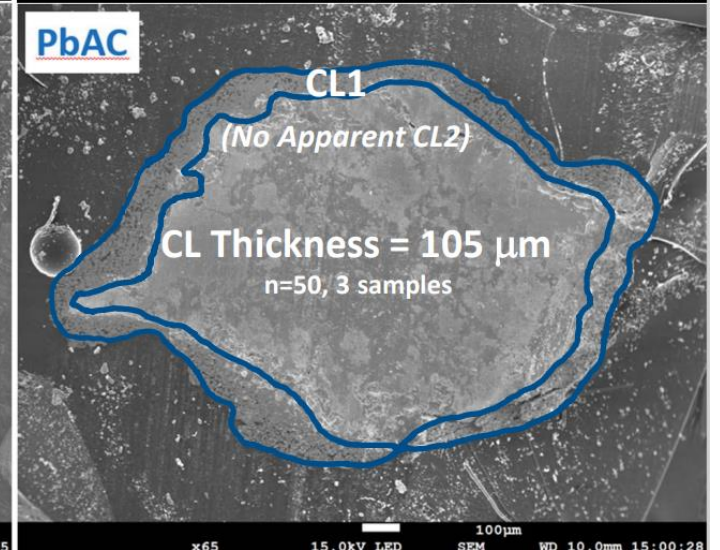
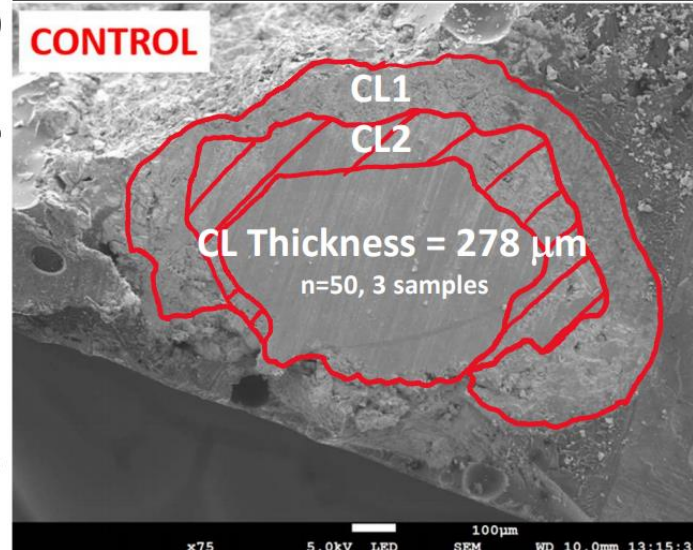
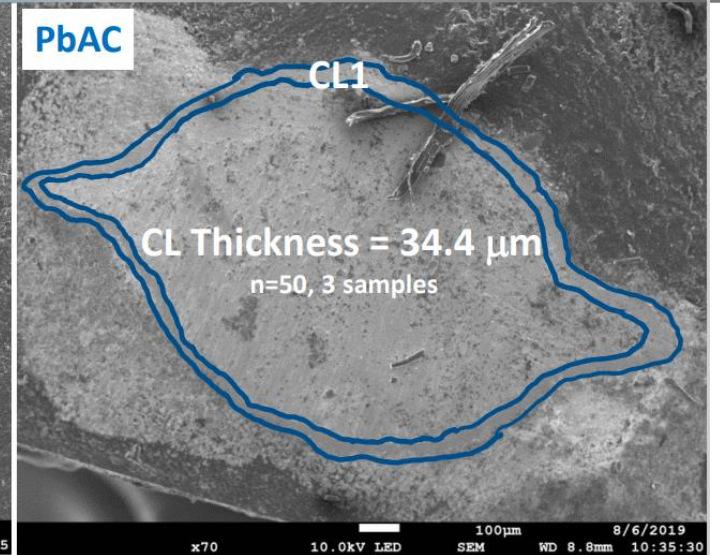
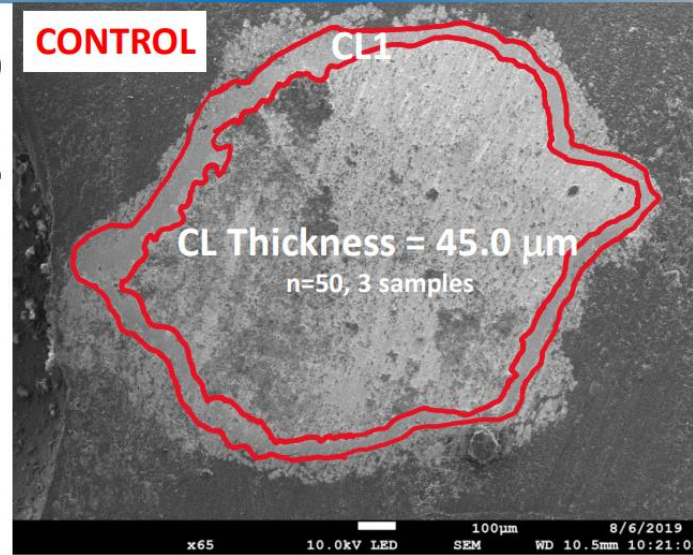
# ENHANCED CORROSION LAYER DELAYS CORROSION FAILURES

PbAC generates a superior corrosion layer to improve SAE J2185 cycle life by >25%

- PbAC layer is 24-60% thinner
- PbAC layer is dense, more uniform – PbAC layer is a single layer
- An effect of altered acid access, improved grid/mass adhesion, reduced grid corrosion

3 Weeks of Cycling

5.5/7 Weeks of Cycling



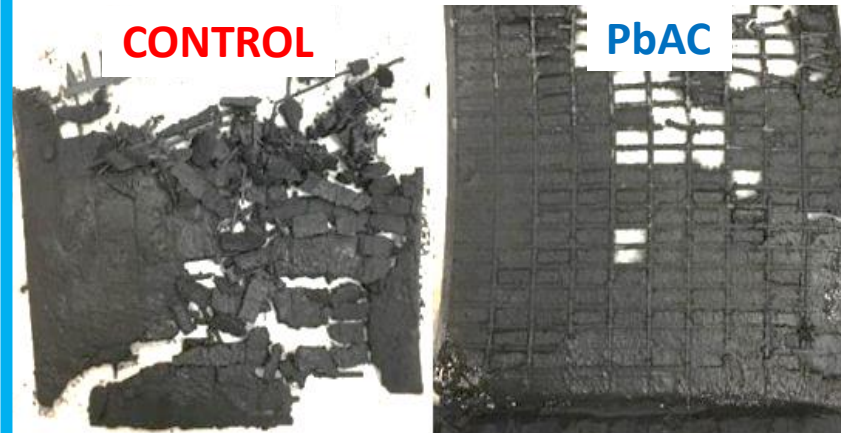
# DRAMATIC IMPROVEMENTS SEEN IN FULL-SCALE TESTING

- Implementation of PbAC results in an enhanced Corrosion Layer
- This new corrosion layer protects grid from further degradation and improves battery life where corrosion is the main failure
- Effects confirmed with:
  - Grid Alloys
    - Ca/Sn, Ca, Sb
  - Grid Types
    - Cast, Expanded, Punched
  - ...and counting!!

## SAE J240 Cycling (75 °C)

Sb, Cast

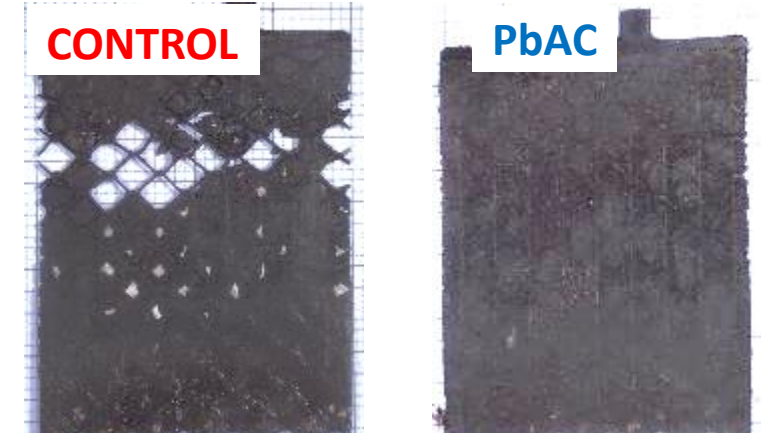
60% improvement using PbAC to delay corrosion



## JIS D5301 Cycling (41 °C)

Ca, Expanded

PbAC delays positive plate corrosion, material loss



## JIS D5302 Cycling (45 °C)

Ca/Sn, Cast

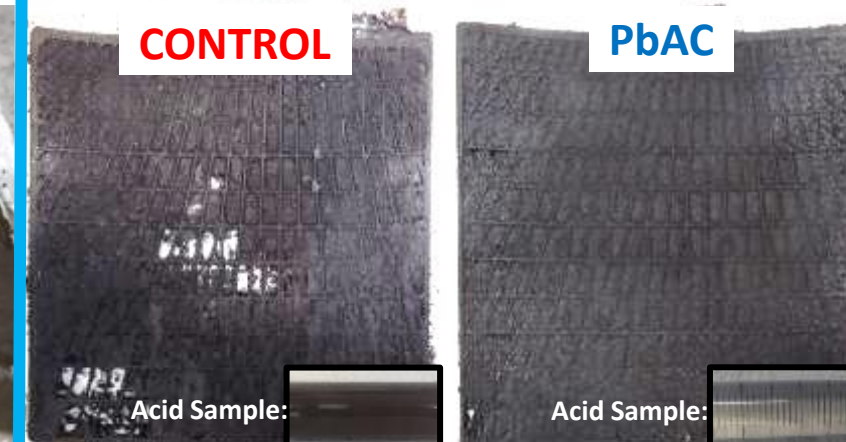
100% improvement using PbAC to delay corrosion



## SAE J2185 Cycling (50 °C)

Sb, Cast

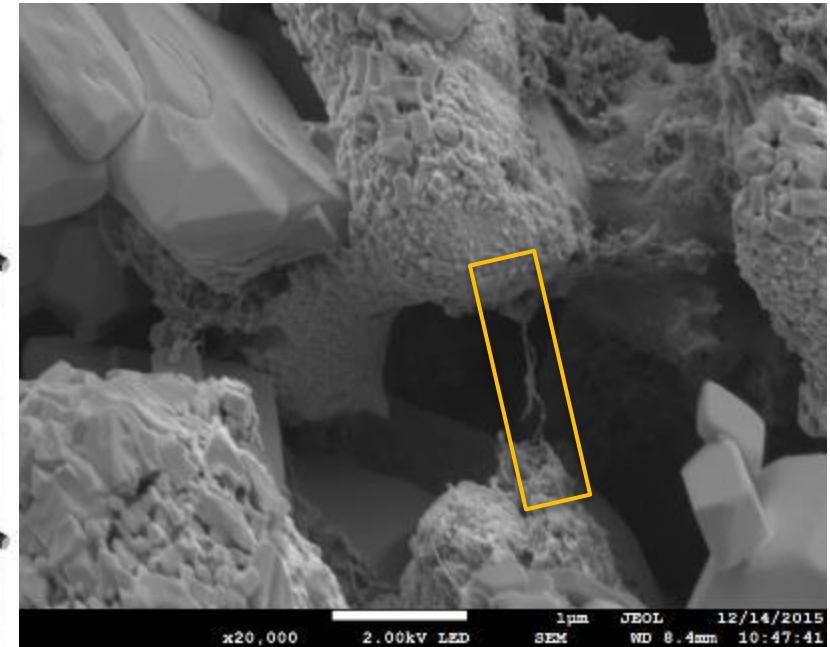
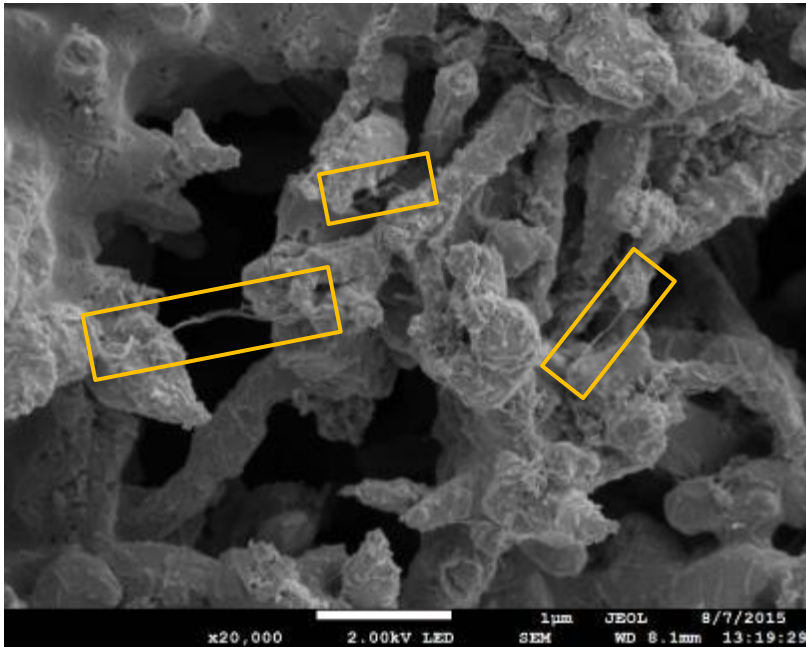
PbAC delayed corrosion and acid decolorization



# MOLECULAR REBAR®: THE NANO-CONNECTOR

## MOLECULAR REBAR PRODUCTS PROVIDE NANOSCALE REINFORCEMENTS

- Act to bring the active material together, reinforcing plate structure → **Enhanced robustness**
- Alter crystal packing to enhance surface area and modify pore structure → **Improved electrical performance**
- Restrict the growth of large, insulating lead sulfate crystals → **Consistency of performance**



*Molecular Rebar Products Change the “DNA” of Your Battery*

# MOLECULAR REBAR®: THE NANO-CONNECTOR



**THANK YOU !**

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