ND*nano* Undergraduate Research Fellowship (NURF)
2011 Project Summary

Student name: Dean Schaetzl
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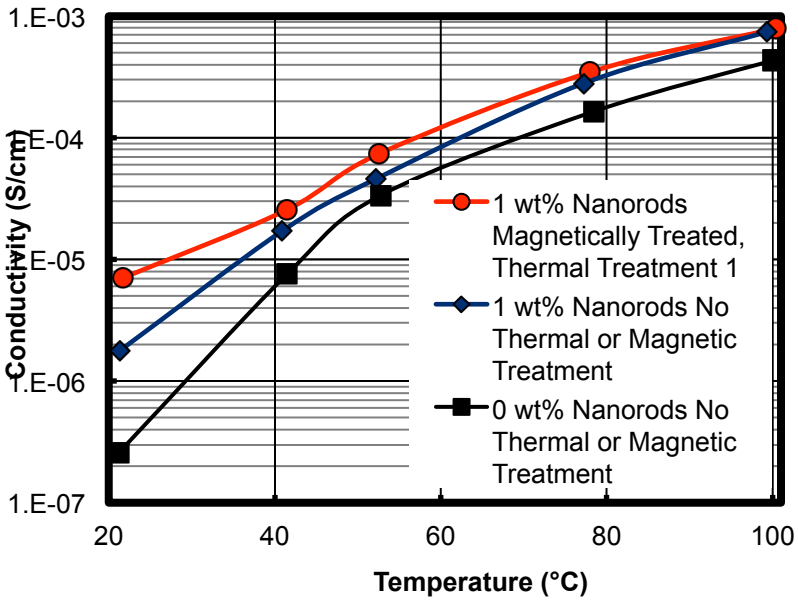
Project title: Aligning Conductive Pathways in Solid Polymer Electrolytes for Lithium-Ion Batteries

Liquid or gel electrolytes currently used in rechargeable lithium-ion batteries can be toxic, explosive, and require a heavy, rigid casing. A solid polymer electrolyte (SPE) would be nontoxic, lighter and flexible without a rigid case, but SPEs do not have high enough conductivity at room temperature. The addition of spherical metal oxide nanoparticles has shown slight conductivity improvement.

The goal of this study was to determine changes in conductivity with high aspect ratio nanofillers, and if alignment to normal of the electrodes may further alter conductivity. We add 1 wt% magnetic, metal oxide Fe_2O_3 nanorods to a poly(ethylene oxide) [PEO]-SPE of PEO:$LiClO_4$. The nanorods increase conductivity 6.6x over the unfilled SPE at room temperature. As much as 10x the amount of spherical nanoparticles are required for similar gains, showing that the aspect ratio of the nanomaterial directly impacts conductivity. We exposed the SPE to a magnetic field and showed a room temperature conductivity increase of 4.1 times over the non-magnetically treated sample, and an overall increase of 27 times over the unfilled sample. While we cannot know the orientation of the NRs from the conductivity data, it is possible that the NRs are being aligned when exposed to the magnetic field and that this alignment is helping to create channels for ion transport.



Work presented/submitted during 2011 NURF program;

Poster: Midwest Institute for Nanoelectronic Discovery (MIND) 2011 Annual Review

Poster: The 4th Annual Undergraduate Scholars Conference hosted by the Notre Dame Center for Undergraduate Scholarly Engagement (CUSE)