

R034-A: Preparation of Graphene-Modified LiFePO₄ Cathode for Li-Ion Battery

Submitted by UND

Principal Investigator: Xiaodong Hou

Request for \$242,266; Total Project Costs \$490,138

Technical Advisor Comments

- 2 reviewers recommended fund and 1 recommended funding may be considered.
- The 51% match comes from Clean Republic.
 - It should be noted that the applicant has been awarded \$148,105 from Research ND for prior phases of this project. The end date for the project is 12/31/2017. They have recently requested an extension to 3/31/18 due to the delayed delivery of a piece of equipment. Commerce has disbursed \$98,835 to date.
- All 3 reviewers felt that the project was likely achievable.
 - 1 reviewer felt that effective humic acid extraction from the leonardite would be a challenging task.
 - 1 reviewer felt demonstrating that high temperature drying is superior to spray drying to produce small particles would be difficult.
 - The applicant has responded that their procedure is superior to spray drying because of its simplicity and cost efficiency – not because of its ability to produce smaller particles.
- Regarding the methodology.
 - 1 reviewer felt the method for humic acid extraction from the leonardite is not proven and will be the most critical success factor.
 - The applicants agree that it is critical and believe they achieve their goal to produce 99% metal-free humic acid from MD leonardite.
 - 1 reviewer felt the approach wasn't innovative, but solid.
 - The applicants feel that it is innovative because other technologies require advanced equipment or expensive starting materials, etc. and aren't realistic for mass production.
- While 2 reviewers felt the scientific/technical contribution could be significant if successful, there were also a few concerns:
 - 1 reviewer felt that the proposal lacked a convincing technical or economical case for a broad market appeal.
 - The applicant believes that it's product can successfully compete with similar materials in an open market.
 - 1 reviewer felt that if the project is tethered to a Clean Republic, the applicability of the innovation may be limited. However, the reviewer was comfortable with the approach if the intention is that Clean Republic is a launching pad to license with bigger manufacturing concerns worldwide.
 - Applicant stated that they are taking a low risk strategy by starting with internal consumption in Clean Republic.
- 2 reviewers were comfortable with the awareness of current research activity. 1 reviewer felt that additional discussion on the competitive landscape of related technologies should have been provided. The ones mentioned are those on the market, not those under development.
 - Applicant responded that they were limited to page length and that products under development are not in the competitive landscape yet.
- All 3 reviewers were comfortable with the knowledge of the project team. However, 1 reviewer noted that there was a potential gap in large-scale manufacturing.
 - Applicant responded that their consultant has experience running 2 factories with a total annual production capacity of more than 10,000 tons.
- All 3 reviewers were comfortable with the project management plan.
- All 3 reviewers felt the proposed equipment was appropriate.
- Overall, 2 reviewers felt that the project could lead to opportunities for manufacturing and development of ND resources.
- Another felt that while the proposed work is likely achievable technical, the economic success in the open market is unclear.

R034-A: Preparation of Graphene-Modified LiFePO₄ Cathode for Li-Ion Battery

Submitted by UND

Principal Investigator: Xiaodong Hou

Request for \$242,266; Total Project Costs \$490,138

Technical Advisor Recommendations

Funding may be considered. This is a relatively low risk project that has the potential to add significant value to a ND resource and create additional manufacturing opportunities in the state. It has the added benefit of partnering UND with a ND private entity. The state geologist stated that ND produces between 30,000 to 130,000 tons of leonardite per year. It would be nice find another product to help stabilize the market and provide another outlet for it.

It appears that the applicant has been having success with earlier stages of work. It would be beneficial to hear more about the current successes. The applicant has stated that the timing of the award is important. They have assembled a strong working team and would risk idled equipment and time lost to recalibrating and retraining if they waited for the completion of the Research ND project before applying for funding from this program. This is understandable. However, it is prudent to successfully finish one stage of funding before moving on to the next.

Suggested Contingencies If Funded

- Research ND project is successfully completed prior to releasing any REP funds.
- If the project is not having success with materials from Leonardite Products based in Williston, the applicant will try using leonardite from American Colloid located in Bowman County.