Sprout Awards grow 'exciting' pilot projects in engineering

By Patrick Gillespie

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From new approaches for tendon injury treatment to biomass-based construction materials, Cornell Engineering's inaugural Sprout Awards are funding unique research projects with the potential to grow partnerships across Cornell.

The awards, announced Feb. 6, are directed at growing teams of investigators pursuing novel research at the intersection of multiple fields.

Rob Kurcoba

"Sprout awards are designed to fill the gap between 'seed' projects and successful sponsorship by an external agency," said Lois Pollack, associate dean for research and graduate studies at Cornell Engineering. "This inaugural round will support five exciting, interdisciplinary projects, with the goal of creating highly competitive proposals for external funding."

The projects include:

Developing tailored treatments for tendon injuries: From the lab to the clinic

A team led by Nelly Andarawis-Puri, the Clare Booth Luce Associate Professor in the Sibley School of Mechanical and Aerospace Engineering, proposes a study to determine the damage component that is lacking in sub-rupture tendon injuries to mount the necessary inflammatory response by using precise laser ablation to differentiate between the effect of matrix micro-rupture and cellular necrosis. The study also utilizes cell-free RNA profiling of different tendon injuries in their mouse injury model and in human samples to make a leap towards managing each injury based on its environment.

"This first aspect alone is highly impactful because of the potential clinical translation of precisely employed laser ablation to promote healing of overuse tendon injuries," Andarawis-Puri said.

Andarawis-Puri is joined by co-investigators Cindy Leifer (professor, College of Veterinary Medicine), Nozomi Nishimura (associate professor, Meinig School of Biomedical Engineering), Iwijn DeVlaminck (associate professor, Meinig School of Biomedical Engineering) and Scott Rodeo (professor of orthopedic surgery, Weill Cornell Medical College).

Engineering retrovirus-like ARC extracellular vesicles for the in-vivo delivery of mRNA into the brain

This work proposed by Shaoyi Jiang, the Robert Langer '70 Family and Friends Professor in the Meinig School of Biomedical Engineering, and Chris Schaffer, professor in the Meinig School of Biomedical Engineering, aims to develop safe, effective, and targeted in vivo delivery of mRNAs into the brain via systemic administration. The team will employ a novel drug delivery system based on an endogenous retrovirus-like extracellular vesicle that naturally occurs in the human brain and explore the therapeutic application of the engineered vesicle to neutral disorders in the central nervous system.

Electrochemical recovery of energy critical metals with inherent carbon removal coupled to bioleaching for a sustainable climate and energy

This project, led by Greeshma Gadikota, assistant professor in the School of Civil and Environmental Engineering, integrates microbial leaching of earth abundant resources, highly selective separation of energy critical metals, and CO2 capture and storage. The leaching and separation are powered using electricity sourced from renewable energy. Buz Barstow, assistant professor in the Department of Biological and Environmental Engineering, is leading the effort on electromicrobial leaching and Gadikota is advancing the technology for metal recovery and carbon management.

"Given the remote nature of mining operations, our technology will unlock clean and distributed manufacturing strategies while removing CO2 from air and emissions from mining," Gadikota said. "Buz and I have shown that the underlying science is feasible. Support from the Sprout Awards will enable us to de-risk key technological bottlenecks for scalable realization."

Developing biomass-DNA/PolyBricks as sustainable architectural building blocks

This study aims to develop novel, DNA-clay-based architectural building blocks beyond the traditional hundreds-year-old brick and mortar. The goal is to create new building structures that are dynamic, interactive and sustainable.

"Built upon our ongoing collaborative research, we propose to engineer sustainable architectural building blocks that are based on biomass DNA materials and PolyBricks," said Dan Luo, professor in the Department of Biological and Environmental Engineering, of his work with co-investigator Jenny Sabin, professor in the Department of Architecture and chair of the new multi-college Design Tech Department in the College of Architecture, Art, and Planning.

"Since biomass DNA is extracted directly from biomass including plants and algae, and since PolyBricks are from clay, the proposed new materials are all renewable and sustainable," said Luo. "Our vision is to integrate biomass DNA materials with architecture design to engineer entirely new architectural building blocks with unique properties such as self-monitoring of microcracks and environmental hazards, self-regulation of water and humidity, and self-adaptive and interactive to the environment."

Designing refractory high entropy alloys for fusion reactors

Fusion energy remains one of the most promising long-term solutions to the climate challenge given both its clean power generation and nearly unlimited fuel sources. However, structural materials that can withstand the extreme conditions of irradiation, elevated temperatures and transient mechanical loads in fusion power generation do not exist.

This research takes a step forward in this pursuit and develop a novel refractory high entropy alloy coating via solid phase processing. The microstructures of the alloy are highly engineered to offer high strength and thermal stability together with significant irradiation damage resistance.

"Modern society is becoming more and more dependent on electricity, with demand steadily increasing as transport, domestic heating and industrial processes are increasingly electrified," said principal investigator Mostafa Hassani, assistant professor, Sibley School of Mechanical and Aerospace Engineering. "To address climate change, there is also a dire need to transform our energy systems to provide electrical power via greenhouse gas-free systems."

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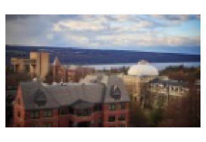
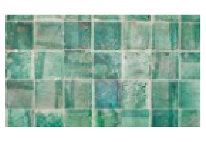


Seed grants foster collaboration across Cornell campuses



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