DE-FOA-0001594

REDUCING EMBODIED-ENERGY AND DECREASING EMISSIONS (REMADE) IN MATERIALS MANUFACTURING

TEAMING PARTNER LIST

UPDATED SEPTEMBER 7, 2016

Organization	Contact Name	Organization Type	Area of Technical Expertise	Description of Capabilities	Contact Information
Clemson University	Michael Carbajales-Dale	R1 Public University	Life cycle assessment, Industrial ecology, Techno-economic analysis	The Energy-Environmental-Economic (E3) Systems Analysis Group, sits within the Department of Environmental Engineering & Earth Sciences (EEES) at Clemson. The group's research focuses on building tools to reduce the environmental impacts of energy systems. The current group focus is on understanding energy and material requirements for renewable energy systems. Our approach includes building engineering-based bottom-up life cycle assessment (LCA) models to generate rigorous estimates of environmental impacts from energy extraction and conversion technologies. Also, developing techno-economic modeling tools to improve the energetic, environmental and economic performance of energy systems. Our methods are applied primarily to energy systems, in an effort to understand and reduce the environmental impacts of conventional thermoelectric generation and substitutes for conventional technologies (e.g., wind, photovoltaics). We are also currently developing optimization capabilities for combinations of electricity generation and storage technologies. A third area of interest is in the mathematical modeling of material and energy flows and accumulations at the economic sector level using input-output techniques..	160 Rich Lab, Computer Court, Clemson University, SC 29625 864-656-0523 madale@clemson.edu
Compact Membrane Systems, Inc.	Stuart Nemser, Ph.D.	Small Business	An advanced materials company with a suite of membrane separation technologies applied to dissolved gas sensing, dehydration, solvent recovery, and olefin/paraffin and aggressive chemical separations	Compact Membrane Systems (CMS) has developed a family of custom amorphous fluoropolymer (CAF) membranes with superb separation capability, for example, olefins (O) from paraffins (P). These CAF membranes have high flux (150 GPU of olefin), high selectivity (40), stable performance and poison resistance. Pilot testing in a refinery is planned for 4Q, 2016. These membranes can enhance refinery performance, dramatically reduce purge stream size and can be used to separate high value olefins produced from low value feed stream (e.g., shale gas). For details see H. Murnen, S. Majumdar, et al, "Stable Membrane Processes for Enhanced Olefin-Paraffin Separations in Refineries and Polyolefin Plant", AIChE 2016 Spring Meeting, Houston, April 11, 2016	335 Water Street, Wilmington, Delaware 19804 snemser@compactmembrane.com 302-999-7996

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School of Chemical Engineering, Purdue University	Professor Nien-Hwa Linda Wang	Public University	Advanced Separation Technologies, which include mixed solvent extraction, adsorption, ion exchange, multi-component chromatography, reaction in chromatography systems, simulated moving bed chromatography, applied to the purification or separation of complex mixtures.	We have developed advanced separation and purification technologies for separating complex mixtures, including advanced simulation tools for multi-component chromatography systems with or without reactions and design and optimization tools for simulated moving bed (SMB) chromatography for the separation of three or more components. We developed the first SMB for insulin purification from a ternary mixture, the first five-zone SMB to recover six sugars from biomass hydrolysates (a complex mixture of 10 components), and the first SMB to separate two flame retardants from a polymer. These SMB processes are an order of magnitude more efficient and more economical than corresponding batch chromatography processes for large scale separation. We also collaborated with the Argonne National Lab in developing a new affinity adsorption process to capture Mo99 from the fission products of low-enriched uranium. Mo99 is the parent of Tc 99m, which is the most widely used medical isotope for diagnosis. This separation process will be used in the first medical isotope plant in the US to produce this isotope by 2019. We have also collaborated with industry in developing new separation processes to recover high-purity polycarbonates, flame retardants, and other polymers from electronic wastes. The separation methods are applicable to the recovery of high purity polymers and chemicals from other polymer wastes. For each polymer recovered from the polymer waste, we save raw materials for synthesis, reduce the energy of producing the polymer by 84%, and reduce CO2 emission by 3 to 6 tons per ton of polymer. We also developed economical ligand-assisted chromatography methods to purify rare earth elements. This new method uses recyclable, safe ligands. This method potentially can reduce the footprint of the purification process by two orders of magnitude and eliminate the environmental risk of disposal of toxic solvents used in conventional purification of rare earth elements. We are developing economical SMB methods to recover high-purity rare sugars with high yield from a waste from paper mills. We are also developing new separation methods for recovering valuable chemicals from coal byproducts and coal ash.	School of Chemical Engineering 480 Stadium Mall Drive West Lafayette, IN 47907-2100 (765) 494-4081, (765) 494-0550 Fax: (765) 494-0805 wangn@purdue.edu

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SRI International	Indira Jayaweera	nonprofit		The research facilities at SRI include more than 1 million ft2 of laboratory and office space and contain a wealth of advanced scientific equipment, including unique instrumentation developed by the staff. The technical library at SRI has about 60,000 technical books, 6400 pamphlets, 133,000 U.S., Canadian, and California State government publications, and 45,600 internally generated research reports. SRI has working arrangements for the use of Stanford University libraries and the United States Geological Survey library. As a member of the Research Libraries Information Network (RLIN), SRI's library staff can access on-line the holdings of over 200 major libraries. SRI has a hollow-fiber spinning line that has the capacity to spin over 1 km per day. We also have fully equipped laboratories with tools that allow for post-treatment of fibers using cross-linking, potting, and module fabrication techniques. SRI also has complete fiber characterization equipment including optical and electron microscopes, tension analyzers and porosity meters. SRI has a custom-built hollow fiber test stations to conduct fiber performance analysis for various applications (e.g., liquid and gas separation applications). SRI has a well-equipped machine shop staffed by expert machinists and welders experienced in prototype fabrication. The shop has automated lathes and milling machines for cost-effective fabrication and has working relationships with local companies that specialize in glass-blowing, ceramic machining, and plasma and thermal spraying techniques. Several CO2 capture test systems (solvent testing, membrane testing, and sorbent testing) are also testing and scale-up testing. Test equipment for high-pressure/high-temperature processing (e.g., hydrothermal test loops for organic conversion and corrosion test systems) is also available. SRI has a state-of-the-art analytical laboratory facility that includes infrared CO2 analyzers, a chemiluminescent ammonia analyzer, gas chromatographs with thermal conductivity and flame ionization detectors, liquid chromatographs (with mass detection), several ion chromatographs for cation and anion detection, a gas chromatograph-mass spectrometer (GC-MS), magnetic and quadrupole mass spectrometers, and wet chemical analytical equipment. Other materials characterization equipment is also available, including: a Cambridge Leo 425 scanning electron microscope with EDX attachment; a Micromeritics helium pycnometer; an automated mercury porosimeter, an automated surface area analyzer; a Philips X-ray diffractometer with automated data acquisition; an X-ray fluorescence analyzer; a Perkin Elmer laser desorption and ionization analyzer; automated polishing and grinding equipment; optical microscopes (Wilde Macroscope, Nikon metallograph); SRI's Fracture Surface Topography Analysis (FRASTA) instrument to visualize failure modes; a surface profilometer and research ellipsometer; TA Associates differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), differential thermal analysis (DTA) equipment; a Netsch high- temperature dilatometer; an Instron mechanical tester with a high-temperature attachment; high- temperature creep testers; Rockwell and Vickers hardness testers, and a Vickers microhardness tester. The electrochemical testing equipment includes: modern high-speed potentiostats (computer interfaced PAR 280, 273); a full range of instrumentation for in-situ measurements of corrosion rates using small amplitude cyclic polarization, potential step polarization, and rotating ring disc techniques; and Solartron 1250, 1255, and 1260 impedance analyzers for AC impedance characterization of solids and interfaces.	Contact Name: Indira Jayaweera, Sr. Staff Scientist and Program Manager Company Name: SRI International Address: 333 Ravenswood Avenue, Menlo Park, CA 94025 Phone: 1-650-859-4042 E-mail: Indira.jayaweera@sri.com

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Universal Technical Resource Services, Inc.	Lowell Seward	Corporation	Metals, Fibers and e-waste	UTRS has been actively engaged in titanium extraction research since 2003 in Butte, Montana. We have developed a patent-pending system and method for extracting and refining titanium that makes use of domestic, non-traditional ore sources to lower costs and reduce pollution. This process is accomplished in two major processing steps; the underlying technology integrates innovative extraction techniques as well as electro-refining and metal processing practices that have been adapted to produce titanium directly from titanium-bearing ores.	Universal Technical Resource Services, Inc. Name: Lowell Seward Address: 950 N. Kings Hwy. Suite 208 Cherry Hill, NJ 08034 Email: lseward@utrs.com Contact Phone: 856-667-6770 x116
ITN Energy Systems, Inc	Neelesh Ullal	Small Business	ITN Energy Systems, Inc. is an innovative technology incubator, R&D accelerator, and product development company.	ITN Energy Systems, Inc. is an innovative technology incubator, R&D accelerator, and product development company. We identify and develop next generation clean and emerging technologies. We use smart science and extensive manufacturing and commercialization experience to bring next-generation products to the marketplace. ITN's core technological competencies arise from our experience with thin-film multilayer devices, nanotechnology, and high-volume roll-to-roll manufacturing enhanced by intelligent process controls. From the beginning, ITN established a culture and process to support efficient commercialization of emerging and clean technologies with emphasis on tackling core manufacturing challenges. Core capabilities include: **Advanced Materials and Processes** Thin film processing of solid-state multilayer device structures Nanoscale engineered materials and patterned devices Flexible electronics Engineered polymers and ceramics **Energy Devices and Clean Technology** Energy generation Solar, fuel cells, and energy harvesting (plasmonics) Energy storage (i.e., batteries) Energy efficiency Window films (active and passive) **Integrated Systems for Clean Technology** Complete system design and implementation Integrated sensor and controls for autonomous operation Integration of multiple functions Combination of energy generation, storage, and control electronics **Roll to Roll Processing with Intelligent Process Controls** Unique high-volume, low-cost manufacturing platform Custom vacuum tool design and fabrication Process optimization and scale up Closed-loop sensor-based controls to maintain product quality over long runs Monolithic integration into devices **Technology Commercialization** From laboratory to fabrication Manufacturability a primary concern from day 1 Extensive infrastructure and strong technology team to rapidly develop and commercialize technology From technology to marketplace Enabling technology solutions to create market pull, cost modeling, and strategic partnerships	Organization Name: ITN Energy Systems, Inc Contact Name: Neelesh Ullal Contact Address: 8130 Shaffer Parkway, Littleton, CO, 80127 Contact Email: nullal@itnes.com Contact Phone: 303.420.1141

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NU-ROCK TECHNOLOGY USA LLC	MARTINA RAHME	TOTAL WASTE UTILISATION TECHNOLOGY AND COMPLETE SITE REMEDIATION	MAJOR WASTE STREAM UTILISATION	ABILITY TO COMPLETELY UTILISE ALL MAJOR WASTE STREAMS GENERATED BY COAL FIRED POWER STATIONS, STEEL MILLS, NON FERRIS METAL SMELTERS, ALUMINA PLANTS AND MINE TAILINGS DAMS AND WE CONVERT THIS WASTE INTO BUILDING MATERIALS AND OR CONCRETE REPLACMENT USING THE NU-ROCK TECHNOLOGY. THE PRODUCTS WE USE ARE 100% SUSTAINABLE AND USE LESS THEN 2% OF THE EMBODIED ENERGY TO MAKE ANY PRODUCT EQUIVALENT TO A CONCRETE PRODUCT	NU-ROCK TECHNOLOGY USA LLC Name: MRS MARTINA RAHME Address: UNIT 90/5 WOODLANDS AVENUE, BREAKFAST POINT NSW 2137 SYDNEY AUSTRALIA (WE ARE IN THE PROCESS OF SETTING UP AN ADDRESS IN THE UNITED STATES, THROUGH THE COMPANY THAT IS SETTING UP ALL OUR COMPANY IN THE USA) Email: martina.rahme@nu-rock.com Contact Phone: +612 409 883 336