

Canada-UK Critical Minerals Technology Partnering Event 26th of June, 2023

Company Profiles

C-THERM

C-Therm Technologies Ltd. (www.ctherm.com)

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C-Therm's purpose is to simplify thermal conductivity testing for the materials of tomorrow.

Accelerating EV R&D with rapid material characterisation: Optimizing thermal management starts with an understanding of the effective thermal conductivity of the materials employed in an EV. C-Therm helps accelerate time to market in assisting R&D groups improve material characterization in quantifying the effective thermal conductivity of materials for use in electric vehicles battery packs and e-motors.

Sensoring adhesive dispensing in battery pack (energy module) production: As OEM's scale electric vehicle production, the industry is looking towards Industry 4.0 and related sensor technologies in the optimization of the manufacturing process. Traceability for quality control and potential liability issues are important. One critical aspect of EV production is ensuring good thermal management of the battery to prevent thermal runaway. Using thermal conductivity data, the MTPS can be applied as a real-time process monitoring solution, able to detect filler settling, air bubbles, and uneven distribution within the glue.

UK objectives:

- To meet researchers & companies working on innovative materials for EV and Hybrid transportation where thermal management is important.
- To connect with UK OEMs and factory engineers seeking sensor solutions for monitoring adhesive dispensing in battery pack production.



Excir Works Corp. (www.excir.com)

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Excir has a nascent hydrometallurgical technology that can recover precious metals from secondary sources such as E-waste, catalytic converters, scrap jewellery and mining concentrate (to name a few) in an eco-friendly manner. This breakthrough technology has the fastest kinetics ever recorded in chemistry, is extremely selective and scalable. Its plant requires minimal CAPEX, has a small footprint, and requires minimal energy and water consumption. It is a step change on emissions when compared to incumbents. The chemistry can be reused multiple times at ambient temperature and can batch process feedstock. Excir's technology produces a provenance of 'green' precious metals not seen in the market today. It has licensed the technology to The Royal Mint of England (TRM) who is building its first commercial plant in Wales that will be operational in Q4/23. The plant will recover the value from recycled E-waste.

UK objectives:

- Raise the profile of our current E-waste partnership with TRM in hopes of finding potential synergies that we can pass along to them for consideration (i.e. feedstock suppliers).
- Discussions on other potential opportunities for the technologies in the mining, battery recycling and automotive sectors.
- Increase the profile of Canadian entrepreneurs to our UK counterparts in order to leverage our collective networks past and present to help them win.



Green Graphite Technologies Inc.(www.greengraphitetech.com)

Gillian Holcroft, CEO and Co-Founder

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Green Graphite Technologies (GGT) is commercializing GraphPure™, a patented, cost effective and environmentally sustainable technology which transforms natural flake graphite (NFG) into lithium-ion battery (LiB)-grade graphite. GGT has also developed GraphRenew™, to produce LiB-grade graphite from recycled LiBs, enabling a circular economy for EV adoption. GGT will be both an operator and global licensor of GraphPure and an operator of GraphRenew.

GGT's GraphPure technology uses a patent pending process to purify NFG to LiB-grade specification with the following advantages: no HF acid used; reduced process water demand; simplified in-situ reagent regeneration; zero liquid effluent; minimal generation of inert solid waste; and process heat provided by electricity requiring no fossil fuels.

UK objectives:

- To seek R&D collaboration with those working on the recycling of lithium ion batteries, upgrading of graphite for lithium ion batteries and/or lithium ion battery manufacturers;
- To establish strategic partnerships to advance GraphRenew and GraphPure development and operation such as: a LiB recycler looking for off-take agreements for their graphite residue or a battery manufacturer looking to source battery grade graphite.



Kingston Process Metallurgy Inc.

Kingston Process Metallurgy Inc. (www.kpm-accelerate.com)

Boyd Davis, Principal

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Kingston Process Metallurgy Inc. (KPM) is an integrated chemical process development company with expertise in scaling technologies and supporting new technology development. Clients are global and typically multinationals, but also include start-ups and niche operations. Projects areas include critical mineral extraction and processing, complicated ore bodies, recycling, green chemistry, new process concepts, improvements to existing processes, electrification, and greenhouse gas reduction. Lab and pilot work is integrated with a strong techno-economics team. KPM has over 60 employees and has been in business over 20 years and has helped bring a number of companies from concept to commercialisation.

UK objectives:

- To meet UK partners and clients for collaboration on developing processes and scaling from concept to commercialisation. KPM has some technology, like graphite purification for batteries and electrorefining, but its core business is chemical process commercialization for clients.
- To meet with ChemTech accelerators to discuss their operations and clients and Kingston's growing ChemTech ecosystem, including a chemical process scale up commercialization hub, RXN HUB to be on-line in 2024.



Lomiko Metals Inc. (www.lomiko.com)

Gordana Slepcev, Chief Operating Officer
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Lomiko is a responsible operator of choice in the energy transition economy; a leader with exploration and development assets in graphite and lithium in Quebec, Canada. Our mission is to create a new energy future in Canada where we will grow the critical minerals workforce, become a valued partner and neighbour with the communities in which we operate, and provide a secure and responsibly sourced supply of critical minerals.

Natural flake graphite extracted from Lomiko's La Loutre project site may undergo a multi-stage, vertically-integrated process to transform the raw material into coated spherical graphite (CSPG) for EV batteries.

The transformation of natural flake graphite to anode-grade material is a multi-step process which includes the production of a flotation concentrate, micronization, spheronization, purification and coating.

Lomiko is in the process of developing a path production and the eventual funding of an integrated pilot-scale plant, the Company is looking at how to best achieve over 99.99% carbon content in their purified CSPG. Research has shown that La Loutre's graphite could accelerate the decarbonization of transport and be used as graphite feed for up to 315,000 electric vehicles per year during the project, eliminating a huge amount of GHGs from the environment! Electric vehicles powered by batteries with Lomiko's graphite could reduce carbon emissions by ~616 kt CO₂e per year, eliminating about 2 natural gas power plants!

UK objectives:

- To meet UK research experts in the fields of graphite processing and upgrading of the anode material.
- To meet those working on graphene and other potential industrial applications of graphite.
- To meet UK partners regarding possible offtake agreements for La Loutre graphite.



Mangrove Lithium (www.mangrovelithium.com)

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Mangrove is a modular, scalable, electrochemical lithium refining platform that converts LiCl and Li₂SO₄ from a wide variety of feedstocks directly into battery-grade LiOH, eliminating complex and costly steps from conventional lithium processing companies.

The technology allows for continuous feeding of liquid lithium-containing feedstocks while outputting high-purity and high-recovery chemicals. It consists of strategically placed membranes and electrodes such that ions are moved from feedstock to product compartments when an electrical potential is applied to the cell. These electrochemical cells are both scaled in size and numbered up to result in a commercial scale throughput lithium refinery.

The electrochemical technology is fundamentally unique: the use of an oxygen/air cathode significantly reduces the voltage and energy consumption during the conversion process; a multi-compartment cell design allows for flexibility in terms of lithium feed concentrations and compositions; the need for managing concentrated chlorine or hydrogen is eliminated; and the design of the system simplifies the balance of plant, making it easier to manage and operate. Mangrove's platform requires low CapEx and allows for lithium refining operations to be established near the point of feedstock extraction or near the site of battery manufacturing.

UK objectives:

- To meet technology developers in the UK that would integrate into our process (e.g., pre-treatment technology such as ion exchange resins, and/or materials companies that are experts in supplying electrodes and electrode materials).
- To establish meaningful partnerships with UK-based companies and research institutions for joint R&D collaborations, ultimately leading to the commercialization of our electrochemical lithium refining technology.
- To validate our technology in the UK market and adapt it to meet British and global market needs by leveraging the expertise and resources of potential partners.
- To explore opportunities for co-development of new products/services that combine Canadian and UK research and technologies in order to strengthen our position within the critical minerals and battery supply chain sectors.

Nanode

Nanode Battery Technologies Ltd. (www.nanodetech.com)

Bing Cao, Chief Executive Officer

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Nanode Battery Technologies pioneers the development of cutting-edge anode technologies for sodium and lithium-ion batteries. As we strive to overcome the limitations of traditional carbon-based anodes, Nanode has successfully created tin-based alloy anodes that propel battery energy storage capacity to unprecedented heights. Our groundbreaking solution improves the anode capacity by ~2.5 times higher than its counterparts, coupled with an impressive charging speed of just 6 minutes.

UK objectives:

- Seeking partners in tin mining, processing, and manufacturing to establish a reliable supply chain.
- Scaling up production of tin-based ribbon and powder products, partnering with experts in metal processing and atomization.
- Identifying potential clients and providing innovative tin-based anode solutions for their energy storage needs.
- Seeking partnerships with experienced companies in battery cathode or full battery assembly for commercial cell demonstrations.
- Inviting collaborations to enhance the cycle life of our tin-based anode technology and drive advancements in energy storage.



**National Research
Council Canada**

**Conseil national de
recherches Canada**

National Research Council of Canada (NRC)

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The National Research Council is the Government of Canada's largest research and technology organization with 14 multidisciplinary research centres across Canada and international partnerships with countries like the UK, Japan and Germany. NRC experts work with academia, government, and SME and MNE partners along the entire technology readiness scale, from fundamental research, to technology development and scale-up, to prototyping and field testing. The NRC also supports research and development through grant and contribution funding to collaborators in academia and industry under government mandated programs.

The NRC's Energy, Mining and Environment Research Centre collaborates with organizations across the sector on Battery Materials, Performance and Safety, Energy Storage Systems, Materials Discovery Acceleration Platforms (MAPs); Mineral Processing Acceleration Platforms (PAPs); Material Characterization; Life Cycle Assessment and Techno-economic Assessment; and Clean Production Technologies. The NRC also works closely with other government departments, including Natural Resource Canada (NRCan), to deliver on the Canadian Critical Mineral Strategy.

The NRC's new Critical Battery Materials Initiative is looking to deploy accelerated robotic platforms and AI/ML approaches to rapidly search and develop new battery materials and critical mineral processes. This four-year initiative to be launched in Fall 2023 will provide grants and contributions to be allocated to qualifying collaborators through calls following program launch.

UK objectives:

to identify clients and collaborators in terms of: Battery minerals processing; Mid-stream upgrading/processing; Battery material manufacturing; and Battery material recycling.

- To identify potential eligible grants and contributions recipients for the NRC's upcoming Critical Battery Materials Initiative
- To identify potential end-users and commercial/implementation partners
- To better understand battery recycling trends/issues and developments in battery materials discoveries/novel battery materials and critical mineral processing



Northern Graphite Corporation (www.northerngraphite.com)

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Northern Graphite is a Canadian, TSX Venture Exchange listed company that is focused on becoming a world leader in producing natural graphite and upgrading it into high value products critical to the green economy including anode material for lithium-ion batteries/EVs, fuel cells and graphene, as well as advanced industrial technologies.

It is a vertically integrated graphite producer, from mine to downstream supply. This allows the opportunity to optimise at each stage of the process and work to identify new ways to both utilise graphite products in the green space, but also ways to improve the processing of graphite to reduce chemical and energy consumption.

Northern is the only significant graphite producing company in North America. Its Lac des Iles mine has been producing graphite for over 30 years. The company also has two large scale development projects, Bissett Creek in Ontario and Okanjande in Namibia. These have "battery quality" graphite and are located close to infrastructure in politically stable jurisdictions.

UK objectives:

- To gain expertise and develop partnerships in the down-stream conversion of graphite concentrates into high purity products for battery manufacturing. In particular: Implementing microbe-based technology, for the removal of impurities from graphite concentrate. This would replace the use of hydrofluoric acid- the conventional process.
- Improving graphite extraction technology
- Improving Battery Anode Material (BAM) technology & production
- Developing and implementing new thermal management systems



Optel Group. (www.optelgroup.com)

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Optel is a technology provider which delivers end-to-end and highly granular traceability solutions which enable companies to unlock the potential of intelligent and digital supply chains. Optchain, Optel's flagship traceability solution, connects all stakeholders across the value chain to ensure complete, real-time visibility for better supply chain performance, carbon footprint tracking, and compliance with regulatory standards. Optel is also developing digital product passports for different sectors.

Optel offers a combination of hardware and software traceability solutions, enabling the tracing of raw materials/products from source through manufacturing, end use to second life and recycling. Primary datasets are captured from value chain participants incl. quality, environmental ie CO2e, social and governance metrics to enable organisations to identify, manage and mitigate risk, as well as improve performance and compliance with global regulations.

UK objectives:

- To accelerate the go to market of Optel's intelligent supply chain solutions within the critical minerals industry by collaborating with leading UK partners to scale innovative technologies to make supply chains more sustainable and resilient.
- Looking for R&D partnerships in simulation, decision making, prediction that supports cradle-to-gate and circular economy.



Québec Metallurgy Centre (www.cmqtr.qc.ca)

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The Québec Metallurgy Centre is a center for technology transfer aimed at supporting the competitiveness of the metallurgical industry through collaborative research and technological development. It is one of the largest applied research centers in Canada focussing on metallic materials and it specialises in developing new alloys, metal transformation, shaping and performance evaluation, the development of metallic materials, solid state forming, foundry, additive manufacturing, surface engineering, metal powders, non-destructive testing and modelling.

The QMC has an experienced team of 50 technologists, researchers and engineers dedicated to applied research. It offers unrivalled expertise in metallic materials and metallurgical processes to manufacturing companies in Quebec, Canada and through international partnerships. Collaborative projects aim to develop new products or optimize production processes.

UK objectives:

- To establish research partnerships with UK centres working in similar fields, especially in the development of new alloys with high added value (Cr, Ni, Ti, Sc, Ta, etc.). These materials require highly controlled processes where QMC expertise can help limit contamination and improve purity.
- To support Canadian companies in establishing UK research partnerships and conduct applied research to develop the use of critical materials.



Vital Metals Ltd. Saskatchewan (www.vitalmetals.com.au)

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Vital Metals Limited is a rare earths exploration and development company with a mining project, Nechalacho, in the Northwest Territories and is building a processing plant in Saskatoon that will produce a Mixed Rare Earth Carbonate used for NdFeB magnet production. Vital Metals focuses on using new technologies for making rare earth mining and beneficiation more efficient and sustainable. It uses the high-capacity, sensor-based, TOMRA ore sorting technology to improve the concentration and beneficiation of its rare earths (which is new for REE) at its Nechalacho project. Vital Metals is also building a calcining and acid leach circuit, which is not common in rare earth processing.

UK objectives:

- To be part of collaborations that advance technologies for rare earth separation and neodymium magnet manufacturing.
- To be part of collaborations on technologies that find new uses for the additional basket of rare earths
- To meet potential partners with innovative technologies for improving visibility in the value chain from mineral extraction to end users in the rare earths space.
- To meet collaborators that could help further our understanding of the fate of REE metals in the environment – Vital Metals ability to manage these risks will provide positive mine and production outcomes, building credibility and a movement towards the production of high temperature magnets, which are critical in both EV and defense systems.

Organisers:



**National Research
Council Canada**

**Conseil national de
recherches Canada**

National Research Council – Industrial Research Assistance Program

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NRC IRAP connects Canadian innovators with international R&D partners to help them grow their business beyond Canada's borders. We create opportunities for firms to explore collaborative partnerships and develop effective multinational consortiums leading to co-innovation projects.

With NRC IRAP's support, Canadian businesses are better equipped to build their innovation capacity, successfully commercialize their technology and become more competitive in the global marketplace.



High Commission of Canada

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The High Commission of Canada in the UK is fully engaged in helping UK organizations collaborate with Canadian R&D and innovation partners. Our Trade Commissioner Service (TCS), located in more than 150 cities worldwide and in six regional offices across Canada, also provides strategic market information and market access solutions to Canadian companies looking to export or invest in the UK, and to British companies planning to invest or expand their operations in Canada.