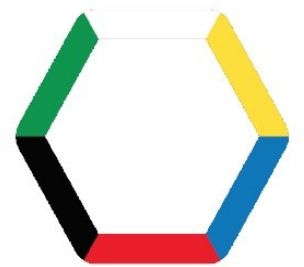


A VERTICALLY INTEGRATED  
ADVANCED MATERIALS  
COMPANY SPECIALIZING IN  
INNOVATIVE CARBON-BASED  
PRODUCTS FOR THE  
RESOURCE EXTRACTION AND  
ENERGY STORAGE MARKETS.

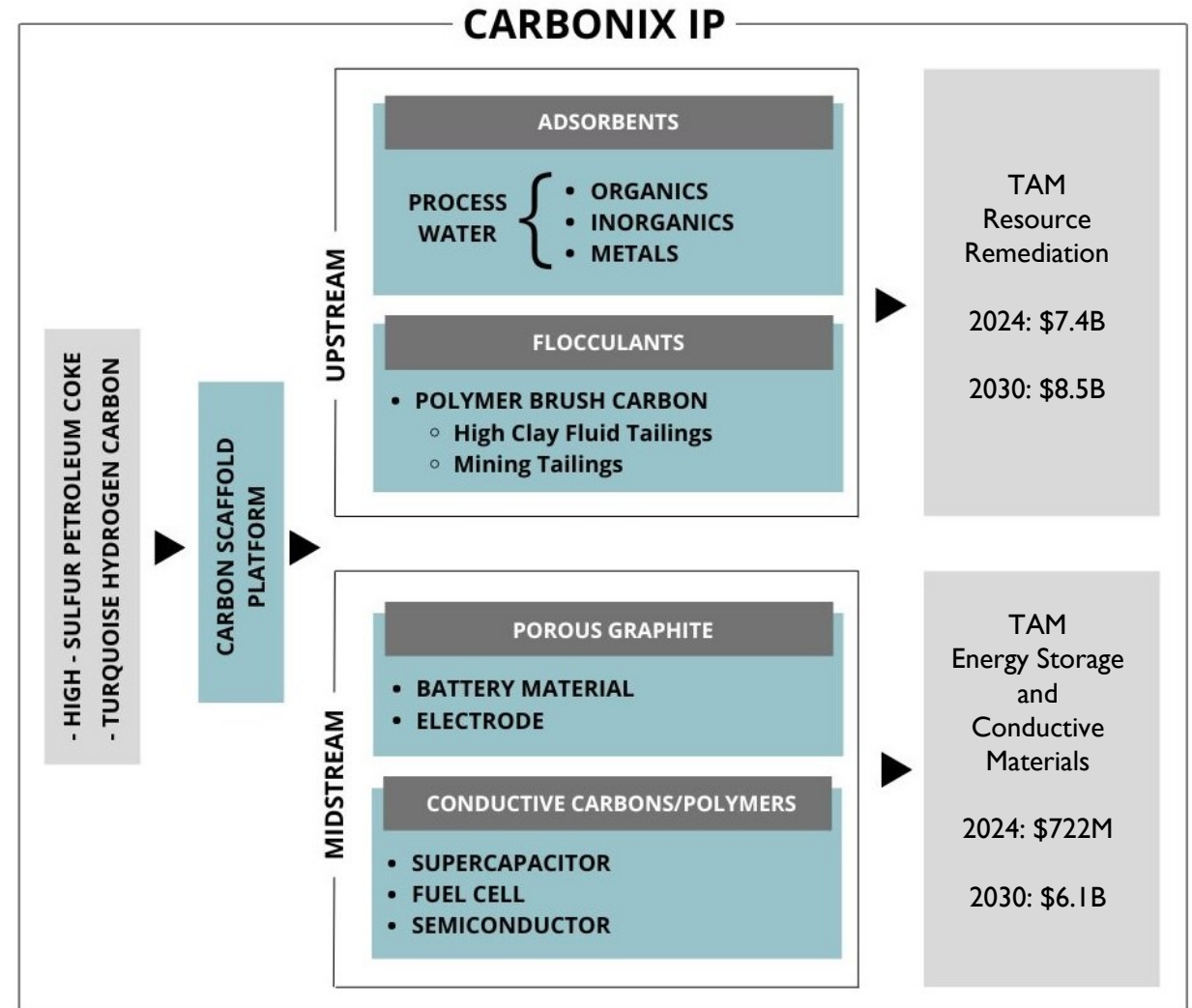
CARBONIX



# COMPANY OVERVIEW

Converting low-value, high-sulfur petroleum coke and turquoise hydrogen precipitated carbon into high-value products

- **Vertically Integrated Operations:** From raw materials to finished products, Carbonix controls the entire value chain, ensuring quality and efficiency.
- **Innovative Technologies:** Our Carbon Scaffold Platform underpins a range of advanced carbon-based products, driving performance and sustainability in industrial applications.
- **Diverse Product Portfolio:** We offer adsorbents, flocculants, synthetic graphite, and conductive carbons/polymers for various industries, including oil sands, resource extraction, and energy storage.
- **Expansive Market Potential:** Targeting significant growth in the resource and energy storage markets.
- **Strategic Advantage:** Combining innovation, market presence, and vertical integration, Carbonix is uniquely positioned to capitalize on emerging opportunities and drive sustainable growth.



# RESEARCH AND DEVELOPMENT

- 3 R&D labs (Peterborough, Oshawa, Kingston)
  - Core carbon scaffold platform
  - Battery and conductive carbons
  - Polymer technologies
- 1 pilot plant (Lakefield)
  - Where processes and products are tested and scaled
- Unique approach combines multiple disciplines
  - Material science, chemistry, process engineering, sustainability, generative AI and Indigenous knowledge
- 5 patent families pending at various stages and in various jurisdictions worldwide



# UPSTREAM APPLICATIONS

Canadian Oil Sands Industry

## **Problem Statement:**

Treatment and reclamation activities of fluid tailings and process water to ensure compliance with environmental regulations and sustainable ecosystem management.



## FLUID TAILINGS

### Current Volumes

- Fluid tailings volume have steadily increased:
  - ~2027: inventories anticipated to exceed approved inventories

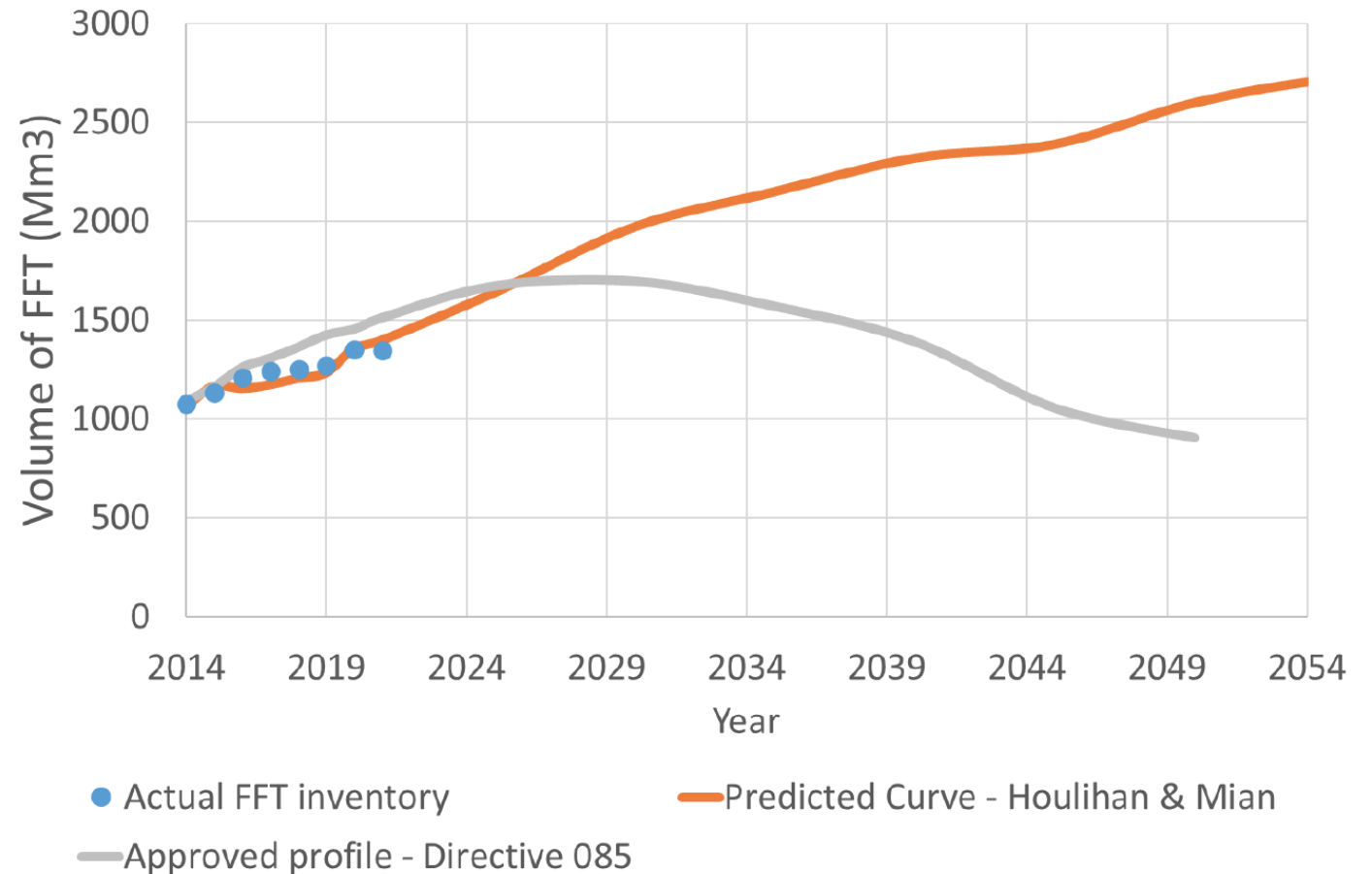
### Projected Volumes

- Projections indicated ongoing exceedance

### Industry challenge

- Operators are required to comply with AER regulations by remaining below approved tailings volume profiles

Predicted and Actual FFT volumes

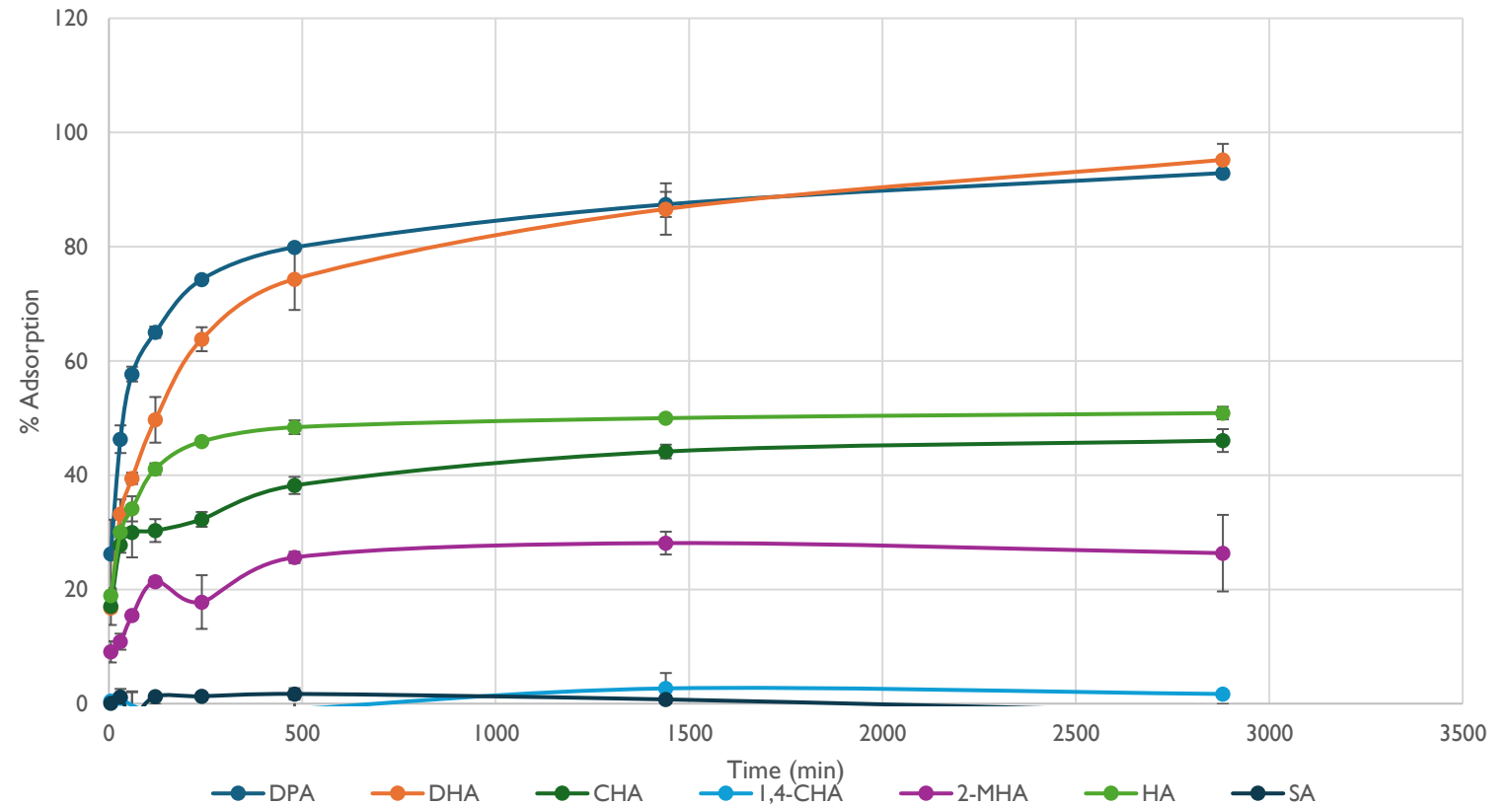


# ORGANICS ADSORPTION

## Naphthenic Acids

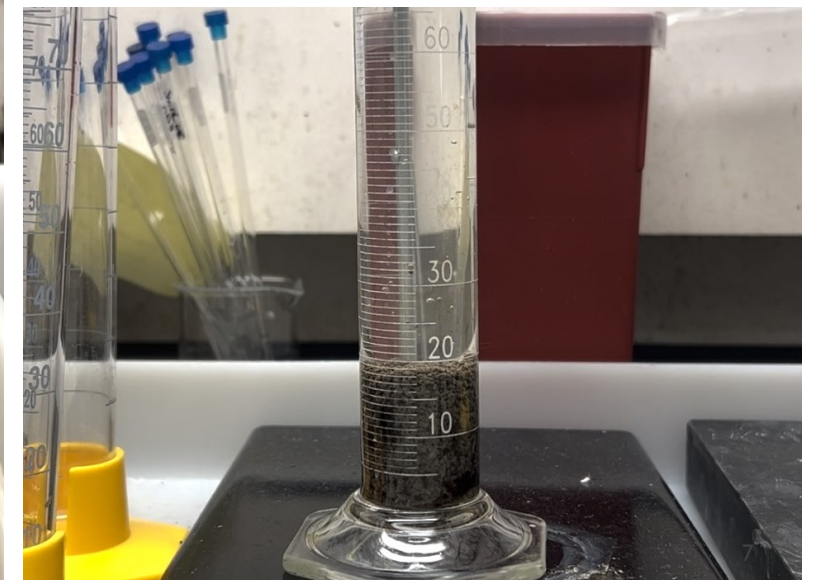
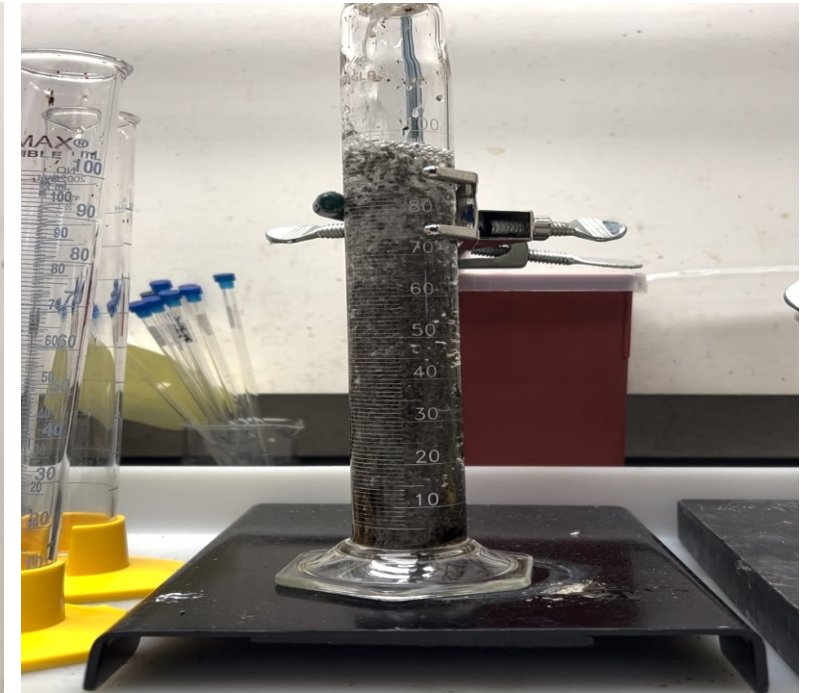
- Many Speciation's
  - Hydrophobic
  - Hydrophilic
- Impact:
  - Adsorption
  - Kinetics
- Requires various types of functionalization

Kinetics of Various Naphthenic Acid Compounds



# FLUID TAILINGS FLOCCULATION

- Significant industry challenge
  - Inventories are large
  - Settle on their own: ~250 years?
- Carbonix solution:
  - Hybrid carbon/polymer
  - Faster settling rates
  - Denser sedimentation
- Facilitates:
  - Greater water recycle
  - Reduced raw water intake
  - COC KPI's



# TOTAL ADDRESSABLE MARKET: OIL SANDS FLOCCULANTS

## Key Growth Drivers:

- Strict Regulatory Requirements
  - Caps on fluid tailings inventories
  - Specific criteria to be met
- Fluid tailings inventories
  - 2024: 1,486 Mm<sup>3</sup>
  - 2030: 1,802 Mm<sup>3</sup>
- Oil Sands polymer market value:
  - 2024: \$7.4B
  - 2030: \$8.5B



# MIDSTREAM APPLICATIONS

## Problem Statement :

- Battery anodes need to achieve higher energy densities
- Current graphite anode material at peak capacity:  $\sim 372$  mAh/g
- Lithium-ion anode graphite mix:
  - Synthetic:  $\sim 65\%$
  - Natural:  $\sim 20\%$ .
  - These materials alone will not facilitate the required energy demands.



# ROBUST INTELLECTUAL PROPERTY STRATEGY

Carbonix has developed a robust intellectual property portfolio to protect our innovative carbon-based technologies. Our focus on cutting-edge research and development has led to the filing of five patent families, each covering critical aspects of our product and process innovations. These patents ensure our competitive edge and support our strategic growth in key markets.

## Key Patent Families:

### Carbon Scaffold Platform Technology

- **Description:** Covers the fundamental methods and processes of our proprietary carbon scaffold platform.
- **Innovations:** High-purity carbon precursor production, tailored surface chemistry for specific applications.

### Conductive Carbons

- **Description:** Encompasses our advanced conductive carbon materials.
- **Innovations:** High electrical conductivity, thermal stability, and mechanical strength.

### Conductive Carbon/Polymer Hybrids

- **Description:** Protects the technology behind our hybrid materials combining carbon allotropes and polymers.
- **Innovations:** Enhanced mechanical flexibility and electrical conductivity, lightweight and durable materials.

### Synthetic Graphite Production

- **Description:** Relates to our processes for producing high-quality synthetic graphite.
- **Innovations:** Non-catalytic and catalytic graphite production methods, high purity and customizable particle size.

### Advanced Flocculants and Adsorbents

- **Description:** Covers our innovative flocculants and adsorbents for water treatment and tailings management.
- **Innovations:** Carbon/polymer hybrid flocculants, tailored adsorption properties, and high efficiency.

## Strategic Benefits:

- **Market Protection:** Safeguards our innovations in key markets.
- **Competitive Advantage:** Strengthens our market position and barriers to entry for competitors.
- **Revenue Opportunities:** Opens avenues for licensing and partnerships.
- **Sustainable Growth:** Supports our long-term strategic objectives in resource extraction, energy storage, and environmental sustainability.

## Upstream

## Midstream

# CARBONIX SOLUTIONS SUMMARY

- **Vertically Integrated Operations:** From raw materials to finished products, Carbonix controls the entire value chain, ensuring quality and efficiency.
- **Expansive Market Potential:** Targeting significant growth in the following markets: oil sands, resource extraction, battery materials, electrodes and semiconductors.
- **Innovative Technologies:** Our Carbon Scaffold Platform underpins a range of advanced carbon-based products, driving performance and sustainability in industrial applications.

## Adsorbents:

- **Advanced Control of Surface Chemistry:** Our proprietary technology allows for precise manipulation of activated carbon (AC) surface chemistry to enhance adsorption of recalcitrant contaminants of concern.
- **Tailored Functionality:** Utilizing a combination of instrumentation and expertise, including BET surface area analysis, MP-AES, XPS, mass spectrometry, electron microscopy, Raman spectroscopy, and x-ray diffraction, we can tune our materials for specific applications.
- **Pore Modification:** Incorporating functional groups on AC surfaces dramatically changes the adsorption extent of small organic acids, improving oil sands process water treatment by up to 20 times.
- **Attributes:**
  - Surface area: 500 – 3,000 m<sup>2</sup>
  - Pore distribution: controllable
  - Morphology: powder, granular
- **Sample Applications:**
  - **Organics:** naphthenic acids, hydrocarbons
  - **Metals:** arsenic, selenium, hexavalent chromium, iron and nickel
  - **Inorganics:** selenite, arsenate, chloride and sodium

## Flocculants:

- **Novel Carbon/Polymer Net Hybrid:** Carbonix flocculants are a carbon polymer hybrid. This synergy enhances floc settling, dewatering, and sedimentation, leading to faster particle aggregation and more efficient water separation in industrial applications.
- **Integration of Advanced Technologies:** The development of Carbonix flocculants involves a combination of advanced instrumentation and expertise, including surface area analysis, mass spectrometry, and electron microscopy. These technologies enable precise tuning of the materials' abilities, enhancing their value and effectiveness in industrial applications.
- **Versatile Application Methods:** Our flocculants can be applied using existing infrastructure, reducing operational costs while maintaining high treatment efficiency.
- **Attributes:**
  - High molecular weight: form large stable flocs, enhanced sedimentation
  - High efficiency: fast aggregation, clarification and dewatering
- **Sample Applications:**
  - Oil and Gas Industry
  - Mining and Mineral Processing
  - Water and Wastewater Treatment

## Synthetic Graphite:

- **Product Duality:** Our carbon scaffold platform precursors enable us to produce both non-catalytic and catalytic graphites. Non-catalytic graphites offer excellent structural integrity and conductivity for battery anodes and electrodes. Catalytic graphites boast increased surface area and superior electrochemical properties. This versatile approach supports various applications, from energy storage to advanced electronics, while emphasizing sustainability and efficiency.
- **Attributes:**
  - **High Purity:** Essential for ensuring consistent performance and reducing impurities in applications.
  - **High Electrical Conductivity:** Provides excellent electrical performance, crucial for batteries and electronic applications.
  - **Thermal Stability:** Maintains structural integrity and performance at high temperatures.
  - **High Mechanical Strength:** Offers durability and resistance to wear and tear.
  - **Customizable Particle Size and Shape:** Allows for optimization in various applications, from anodes in batteries to conductive coatings.
  - **Low Coefficient of Thermal Expansion (CTE):** Reduces the risk of thermal stress and deformation in high-temperature environments.
  - **Controlled Surface Area:** Enhances the material's reactivity and capacity in energy storage and catalysis applications.

## Conductive Carbons/Polymers:

- **Leveraging Skills:** Combining carbon allotropes and polymer science expertise to produce tailored conductive carbons with exceptional electrical properties. This combination results in versatile materials that significantly enhance conductive performance in applications in battery materials, semiconductors, sensors, and advanced composite materials.
- **Conductive Carbons:**
  - **High Electrical Conductivity:** Essential for energy storage and electronic applications.
  - **Thermal Stability:** Maintains performance at high temperatures.
  - **Mechanical Strength:** Provides durability and longevity.
  - **Customizable Surface Area:** Enhances reactivity and performance
- **Carbon as Catalyst:**
  - **Pore Size Distribution:** Tailored pore sizes allow for efficient mass transfer
  - **Metals Functionalized:** creates highly active catalytic sites
- **Conductive Polymers:**
  - **Electrical Conductivity:** Combines the conductivity of carbon and polymers.
  - **Mechanical Flexibility:** Offers enhanced flexibility, for enhanced strength.
  - **Durability:** Provides robust performance under mechanical stress.
  - **Processability:** Easy to process and fabricate into various forms, allowing for diverse application possibilities

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