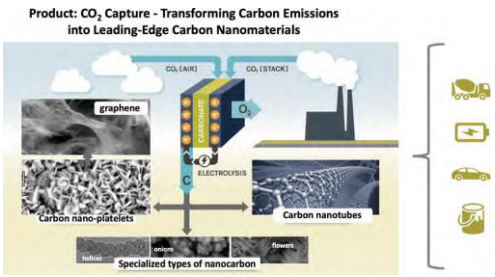
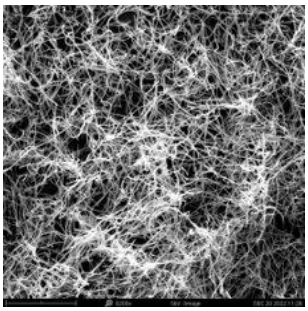
Carbon Nanomaterials from Carbon Dioxide – A Sustainable, Affordable Nanomaterial

Carbon nanotubes have attracted considerable interest since their discovery in the 1990's due to their remarkable mechanical, electrical and thermal properties. These materials have been used in a variety of applications ranging from reinforcements in polymers and advanced plastics, conductive inks, electrodes for advanced batteries, and displays. Broader application in commercial products has been hampered by the cost of the carbon nanotubes due to the energy intensive and costly processes that are typically used in their production.





Using an alternative method to produce carbon nanomaterials from carbon dioxide via an electrochemical splitting reaction[1,2], a pilot plant has been constructed at the Shepard Energy Center in Alberta, Canada using technology developed by Carbon Corp. and its parent company C2CNT LLC. The pilot plant is designed to 200 tonnes of carbon nanomaterials per year and has successfully demonstrated the synthesis of multiwall carbon nanotubes, carbon nanoonions, carbon nanopearls, and carbon nanobamboo from carbon dioxide captured from the flue gas of a commercial power plant using its **Genesis Device®**. For every tonne of nanomaterials produced via the **C2CNT®** technology, 4 tonnes of carbon dioxide are removed from the effluent! CO_2 avoidance is then amplified though the addition of carbon nanomaterials to exiting materials from the enhanced properties.

These carbon nanomaterials are produced by a process that converts the greenhouse gas, carbon dioxide into a useful material with a broad range of potential applications. The process is less energy intensive and uses less expensive starting materials than conventional gas phase nanomaterial synthesis processes. As a result, these nanomaterials are less costly than those produced by conventional processes. The electrochemical process can be tailored to produce a variety of carbon nano allotropes, as seen on Nanowerk.com.

Benefits

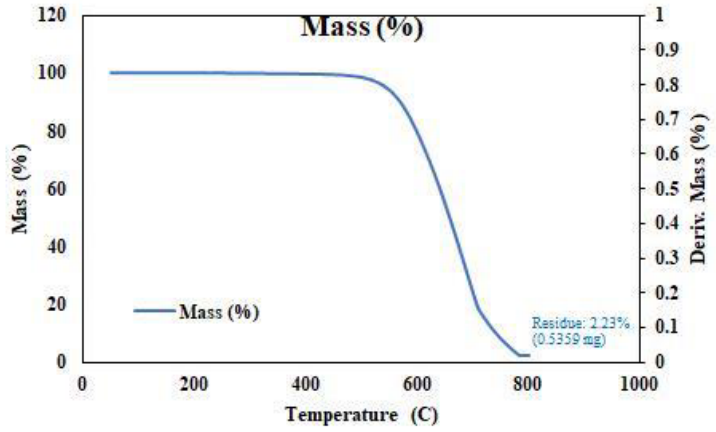
- Sustainable material made from captured waste carbon dioxide (each tonne of carbon nanotubes removes over 4 tonnes of carbon dioxide!)
- Lower cost than conventional gas phase grown nanotubes
- Tailorable process can produce multiwall carbon nanotubes of select sizes and aspect ratios
- Potential applications include composites, coatings, conductive pastes, concrete, batteries, and tires

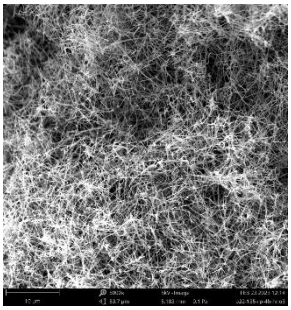
[1] "One post synthesis of carbon nanofibers from CO_2" *Nano Letters*, 2015
[2] "Controlled Transition Metal nucleated Growth of Carbon nanotubes by Molten Electrolysis of CO_2" *Catalysts*, 2022

Carbon

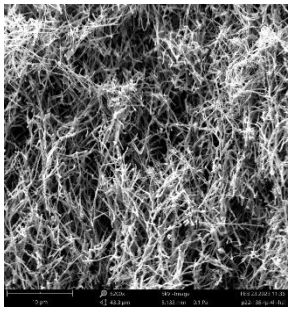
Carbon nanotubes:

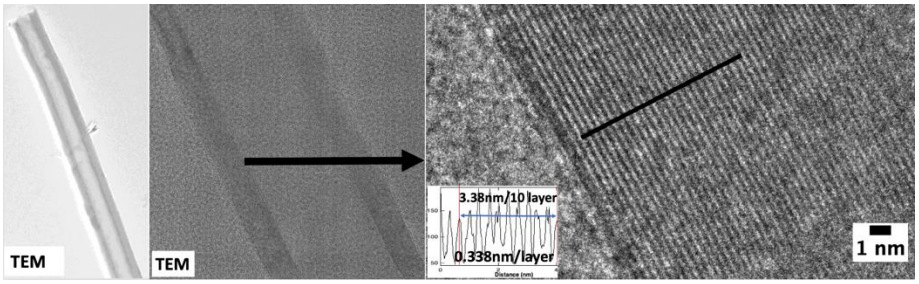
Description	Composition
Multiwalled Carbon Nanotubes Diameter: 40-100 nm or 100-200 nm Length 7-15 µm	>96%*
Catalytic residue Fe, Cr, and/or Ni	<4%
Combustion point based on inflection point in TGA	~610^{o}C
*Based on TGA oxide residue	

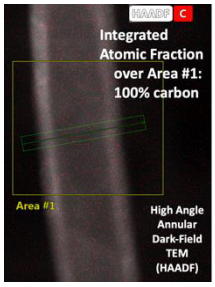


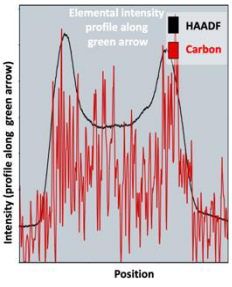


SEM









Carbon nanoonions:

Description	Composition
Carbon Nanoonions Diameter 1- 3 µm	>95%*
Catalytic residue Fe, Cr, and/or Ni	<5%
Combustion point based on inflection point in TGA	~610^{o}C
*Based on TGA oxide residue.