

Industry 4.0 and Material Science

The History of Industrial Revolutions

Starting with the use of water and steam-powered machinery in the late 18th century, the world has experienced three industrial revolutions, and is entering a fourth. **The first industrial revolution** saw the gradual replacement of human and animal power with machines to mass-produce finished goods.

The second industrial revolution occurred in the late 19th century up to the beginning of World War 1 and is recognized by the appearance of assembly lines, popularized by Henry Ford at the Ford Motor Company, which allowed rapid mass production of products while also ensuring consistent quality.

The third industrial revolution occurred in the middle of the 20th century and is characterized by the shift from analog to digital electronics, including integrated chips, microprocessors, computers, digital phones, culminating with the internet.

We are entering a **fourth industrial revolution**, often referred to as Industry 4.0, which is considered the amalgamation of enhanced technology in manufacturing coupled with mass data analysis, culminating with an emphasis on efficiency in production with less waste. On a more granular level, additive manufacturing, improved electronics and battery systems, robotics, smart materials including nano and biotechnology, and the internet of things are considered part of the fourth industrial revolution.

How CPG Is Shaping the Future

Scientists at Cambridge Polymer Group (CPG) have been actively involved in many aspects of Industry 4.0 for years. **Additive manufacturing** relies on a deep understanding of polymeric materials and their response to temperature, radiation, and their utility in specific applications.



CPG scientists have also worked with **battery and fuel cell technologies** on a variety of projects, assisting clients with **material selection** and enhancement for membrane technology, performing **root cause analysis** on manufacturing lines resulting in device failures, and working on design modifications in battery systems. **Modern batteries and fuel cells** frequently utilize membranes and separators which are critical to their function and almost invariably polymeric in nature. The demanding thermal and chemical environment for these applications makes special demands on the polymers that are used.

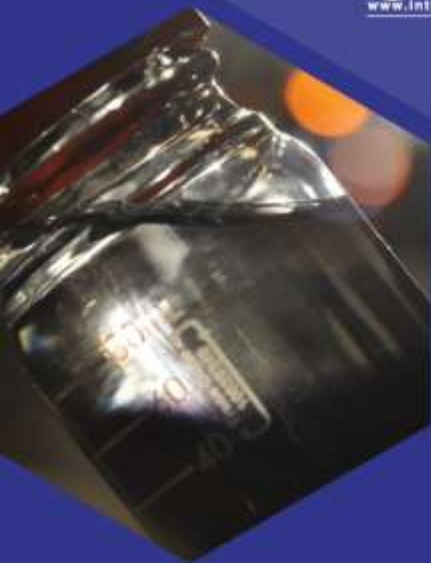
CPG has worked with **robotic systems** requiring unique material formulations for hostile environments such as oil wells and medical devices and has designed accelerated aging conditions to assess the suitability of novel materials for robotic systems.

Our experience in the environmental response of materials, e.g., **smart materials**, allows us to consider how these materials can be employed to improve manufacturing processes.

Lastly, the increasing desire to **reduce waste**, particularly polymeric waste, by employing **reusable plastic technology or degradable materials** relies on the material characterization and material knowledge found in the scientists at CPG.



ANALYTICAL TESTING
BIOMEDICAL MATERIALS
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Cambridge Polymer Group, Inc. is a contract research laboratory specializing in materials. We partner with our clients to solve the world's toughest polymer problems utilizing our multi-disciplinary research team and full service laboratory.

We work with clients throughout the product life cycle to:

- Develop new materials
- Design prototypes for proof-of-concept studies
- Create and execute experimental design
- Validate and verify manufacturing processes
- Perform root-cause analysis in product failures

Cambridge Polymer Group, Inc. was founded in 1996 to provide a cost-effective resource for testing, research and development to clients who need periodic access to Ph.D.-level scientists and their support structure. We have developed a host of testing methods and materials for our clients, which number more than 1,000.

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