

## Why Nanoparticle Coatings are Essential for Electrochemical Conversion

Nanoparticles are becoming significant in many industries, from chemicals to food manufacturing and electronics to pharmaceuticals, because of their wide range of benefits. When used to manufacture coatings, nanoparticles significantly improve components and processes in the energy, security, and technology sectors, and one such example is their role in electrochemical conversion. Nanoparticles are used in coatings in electrochemical conversion as they enhance the properties of materials by offering higher efficiency and stability; therefore, this blog post will explore why nanoparticle coatings are essential for electrochemical conversion.

### What are Nanoparticles?

Nanoparticles are particles between 1 and 100 nanometers in dimension and can be natural, incidental, or manufactured materials. Their small size leads to a very high surface area-to-volume ratio and more advanced chemical and physical properties than bulk materials. Other properties can have significantly favorable effects, such as optical properties, reactivity, and toughness, but these depend on the size, shape, and structure of the nanoparticles. [\[1\]](#)

### What is Electrochemical Conversion?

Electrochemical conversion is a process in energy technology through which chemical energy in active materials is directly converted into electrical energy via electrochemical techniques. An important component in electrochemical conversion is the two electrodes inside an electrochemical cell, the anode and the cathode, separated by an electrolyte. The electrochemical conversion process involves an electric current being transferred through the cell, resulting in a chemical reaction at the electrodes. Electrons are released from the anode onto an external circuit, which are transferred to and accepted at the cathode.

### How Nanoparticles Improve Electrochemical Conversion

Nanoparticles are used as coatings for electrodes to improve the efficiency, rate of conversion, and other aspects of the electrochemical conversion process. [\[2\]](#) Applying a nanoparticle coating to an electrode can increase its electrochemical capacitance and creates an unlimited charge-discharge cycle life within the electrochemical cell. As a result, the devices end up with an increased life span, higher power, and higher reliability, all of which contribute to a better energy storage system in a wide range of applications. [\[3\]](#) The use of nanoparticle coatings can also reduce the cost for expensive materials, such as Platinum, Iridium or Ruthenium, as a result of the higher active surface area to weight ratio of nanoparticle coatings compared to standard thin film coatings.

### Key Benefits of Nanoparticle Coatings

- Different coatings are available for carbon-based materials, metals, and metal oxides.
- Enhanced conductivity, selectivity, and stability

- Increased efficiency of chemical reactions
- Increased surface area of the electrode, resulting in more reaction sites
- Higher rate of conversion
- Longer cycle life
- Offer protection and longevity
- Cost reduction compared to thin film coatings of expensive materials

Nanoparticles can be manufactured in various shapes, sizes, and compositions to create optimal catalytic properties, which, when used as coatings, will improve the reactivity and selectivity during electrochemical reactions. Additionally, coating an electrode will enhance its durability and stability, preventing corrosion and reducing the loss of active materials.

### Applications of Nanoparticle Coatings in Electrochemical Conversion

Many electrochemical conversion processes benefit from nanoparticle coatings, including carbon dioxide reduction and hydrogen production. Nanoparticles improve biological hydrogen production (BHP) and carbon dioxide reduction by increasing surface area to improve the rate of electron transfers. The size of the nanoparticles used in coatings also controls the activity and selectivity of catalysts in chemical reactions.

### Nikalyte and Nanoparticle Technologies

Nikalyte is a leading global supplier of nanoparticle coating equipment for research and development (R&D) and commercial use across various industries. Owing to our expertise in the field of nanoparticle research, our products and services are used in battery technology, green hydrogen production, cell binding, biosensors, nano-photonics, and much more.

Contact a member of [Nikalyte](#) today to learn more about nanoparticle coatings and their benefits in electrochemical conversion and other applications.

### References

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