Exploring the spatiotemporal dynamics of oxygen evolution in nickel (oxy)hydroxide electrodes through activity-based fluorescent molecular imaging techniques

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Lay Abstract

Oxygen evolution is a key process in clean energy technologies, such as batteries and hydrogen production. However, scientists still don't fully understand how and where oxygen forms on electrode surfaces over time. This missing knowledge limits how efficiently we can design energy storage and conversion systems. Our research will use an advanced imaging method—fluorescent molecular sensing—to track how oxygen and oxygen species form in real time on special electrode materials.

These electrodes, made of nickel (oxy)hydroxide, are commonly used in energy systems. We will develop sensors that light up when they detect reactive oxygen species (ROS), which are byproducts of oxygen evolution. This will help us uncover hidden patterns and interactions that affect the efficiency of the reaction. We will also explore how factors like material composition (such as the presence of iron) and operating conditions (like pH and electrical current) influence oxygen production.

By understanding the detailed relationship between oxygen evolution and electrode materials, we aim to improve the design and performance of energy devices. This could lead to more efficient and durable batteries, electrolyzers, and other clean energy technologies. Our research brings together experts in chemistry, materials science, and catalysis to develop innovative ways of studying and optimizing energy materials for a more sustainable future.