Deciphering the deep dynamics of electric charge

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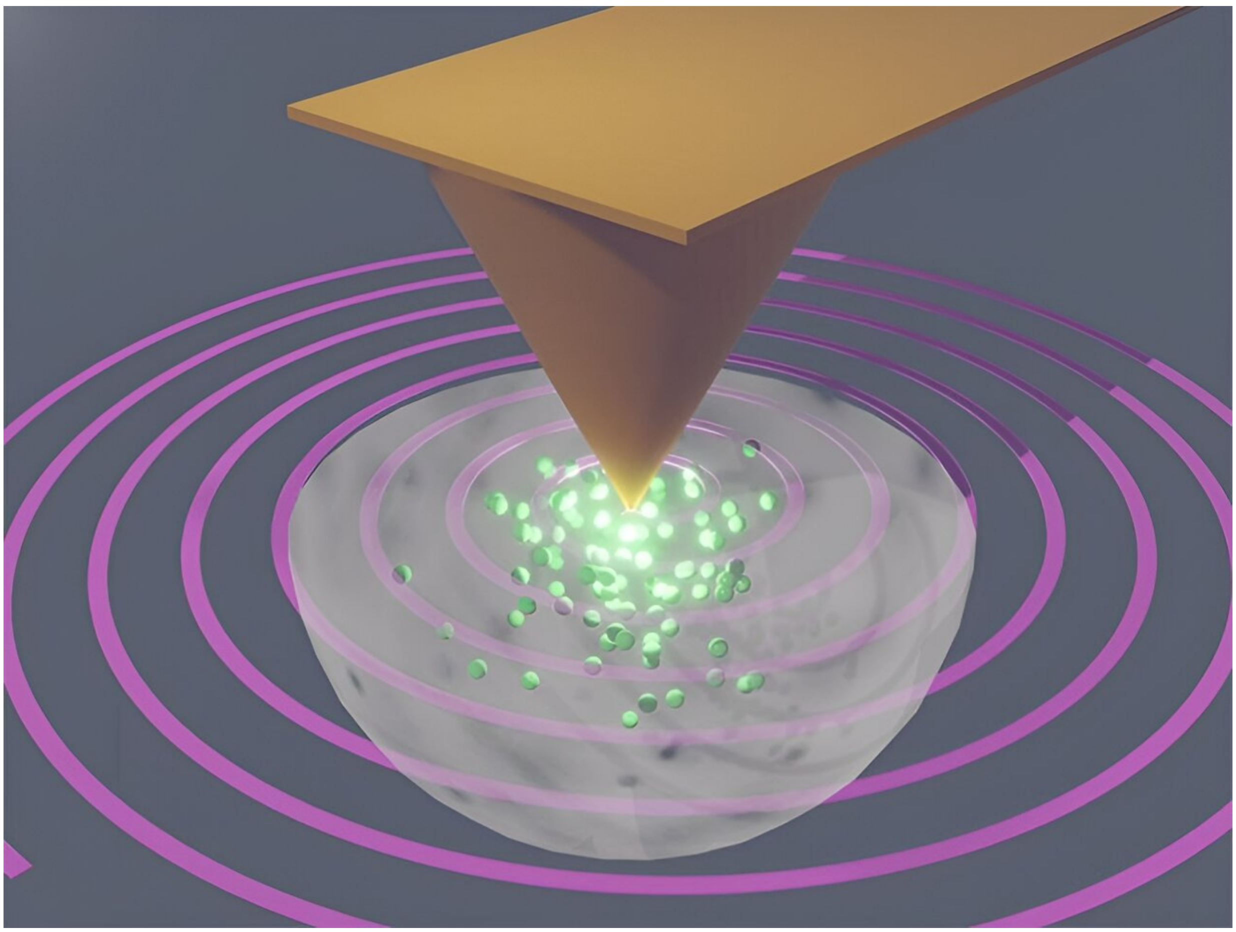

Spiral-tip motion combined with image reconstruction techniques is an approach that can help scientists better understand the behavior of an electric charge at the microscopic level, essential for improving batteries and electronic devices. Credit: Stephen Jesse/ORNL, U.S. Dept. of Energy

Research led by Oak Ridge National Laboratory's Marti Checa and Liam Collins has pioneered a groundbreaking approach, described in the journal *Nature Communications*, toward understanding the behavior of an electric charge at the microscopic level.

Their findings could improve efficiency, life span, and performance in batteries, solar cells, and other electronic devices.

In the paper, the team explained their approach, which enables visualizing charge motion at the nanometer level, or one billionth of a meter, but at speeds thousands of times faster than conventional methods.

Collins described the technique as similar to having a high-speed camera that enables detailed videos of a hummingbird's wings in motion, where previously only blurry snapshots were possible.

To achieve this capability, they employed a scanning probe microscope equipped with an automated control system that enables a unique spiral pattern for efficient scanning and advanced computer vision techniques for data analysis. The rapid, thorough view of processes demonstrated in the new approach was previously unattainable.

"The method introduced in this study expands the toolkit available to users at the Center for Nanophase Materials Sciences at ORNL, facilitating exploration across various devices and materials," Checa said.

More information: Marti Checa et al, High-speed mapping of surface charge dynamics using sparse scanning Kelvin probe force microscopy, *Nature Communications* (2023). DOI: 10.1038/s41467-023-42583-x

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