Achieving dynamic imaging of interfacial electrochemistry

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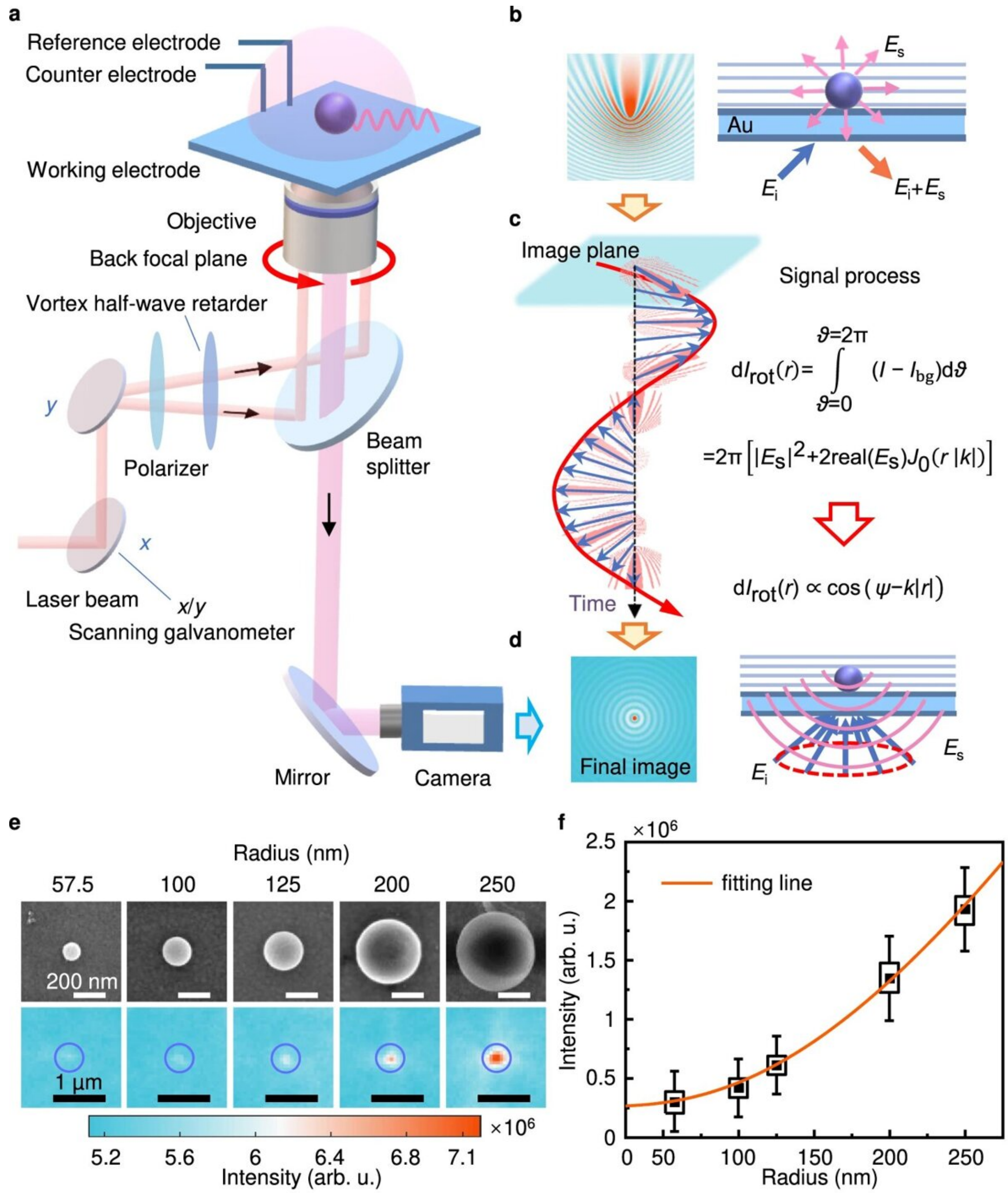

Principle of azimuth-modulated plasmonic scattering interferometric microscopy. **a** Schematic of the plasmonic imaging setup. The azimuth of the surface plasmonic wave was modulated by rotating the incident location of the beam on the back focal plane (red arrow) using a *x*/*y* scanning galvanometer. Scattering light was recorded with a CCD camera. **b** Principle of plasmonic scattering interferometric imaging. The objective-scattered surface plasmons (E_s, pink arrows) interfered with the excited incident surface plasmon E-field (E_i, light blue lines), resulting in a parabolic-like interference pattern. **c** Signal processing of plasmonic images. The integral of the modulated surface plasmonic wave at any azimuthal angle (blue arrows) is acquired, while the surface plasmonic wave is eliminated according to the formula. **d** Principle of azimuth-modulated plasmonic scattering interferometric microscopy. Only the objective-scattered surface plasmons (E_s, pink arc) are acquired. **e** SEM and azimuth-modulated plasmonic scattering interferometric images of PS nanoparticles with various sizes (scale bars: 200 nm and 1 μm, respectively). **f** Calibration curve for a plot of plasmonic intensity versus radius fitted with Eq. 17. Error bars represent mean ± 2 standard deviation ($n_{r57.5} = 243$, $n_{r100} = 380$, $n_{r125} = 377$, $n_{r200} = 273$, $n_{r250} = 49$), and the centers of the error bars (black spot) represent mean values. Source data are provided as a Source Data file. Credit: *Nature Communications* (2023). DOI: 10.1038/s41467-023-39866-8

A research team led by Prof. Liu Xianwei from the Department of Environmental Science and Engineering of University of Science and Technology of China (USTC) of the Chinese Academy of Science (CAS) has made progress in the dynamic imaging of interfacial electrochemistry. The results were published in *Nature Communications* under the title of "Dynamic Imaging of Interfacial Electrochemistry on Single Ag Nanowires by Azimuth-modulated Plasmonic Scattering Interferometry."

The catalytic conversion of pollutants is a pivotal technique in water pollution control. Investigating the dynamic changes of active sites in environmental catalytic materials during the pollutant conversion process is crucial for understanding the structure-activity relationship of these materials, deciphering the catalytic mechanism, and designing and developing new environmental catalysts.

While there is significant interest among researchers in analyzing the active sites of nanomaterials, challenges persist in studying the dynamic progression of reactions at the interface of individual nanomaterials in mild aqueous environments.

In response to the aforementioned challenges, the research team developed a high-resolution plasmonic scattering interferometric imaging technique. By modulating the incident light, they effectively eliminated interference from reflected light, achieving surface plasmonic scattering interferometric imaging with high spatial resolution and robust anti-interference capabilities.

Taking the surface electrochemical reactions over silver as an example, the research team tracked in situ the dynamic electrochemical transformation process of a single silver nanowire in solution, spatially inscribed the distribution of the nanowire reaction, and provided key evidence to establish the relationship between the nanowire surface defects, reconfiguration, and reaction activity.

This label-free imaging analysis method can be integrated with techniques like electron microscopy to characterize the structure and chemical composition of nanomaterials. It offers an effective analytical method and technological platform for high-resolution in situ imaging of pollutant catalytic conversion dynamics and for deciphering their structure-activity relationships.

More information: Gang Wu et al, Dynamic imaging of interfacial electrochemistry on single Ag nanowires by azimuth-modulated plasmonic scattering interferometry, *Nature Communications* (2023). DOI: 10.1038/s41467-023-39866-8

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