Imaging of electronic molecular orbitals of single molecules using field emission microscopy

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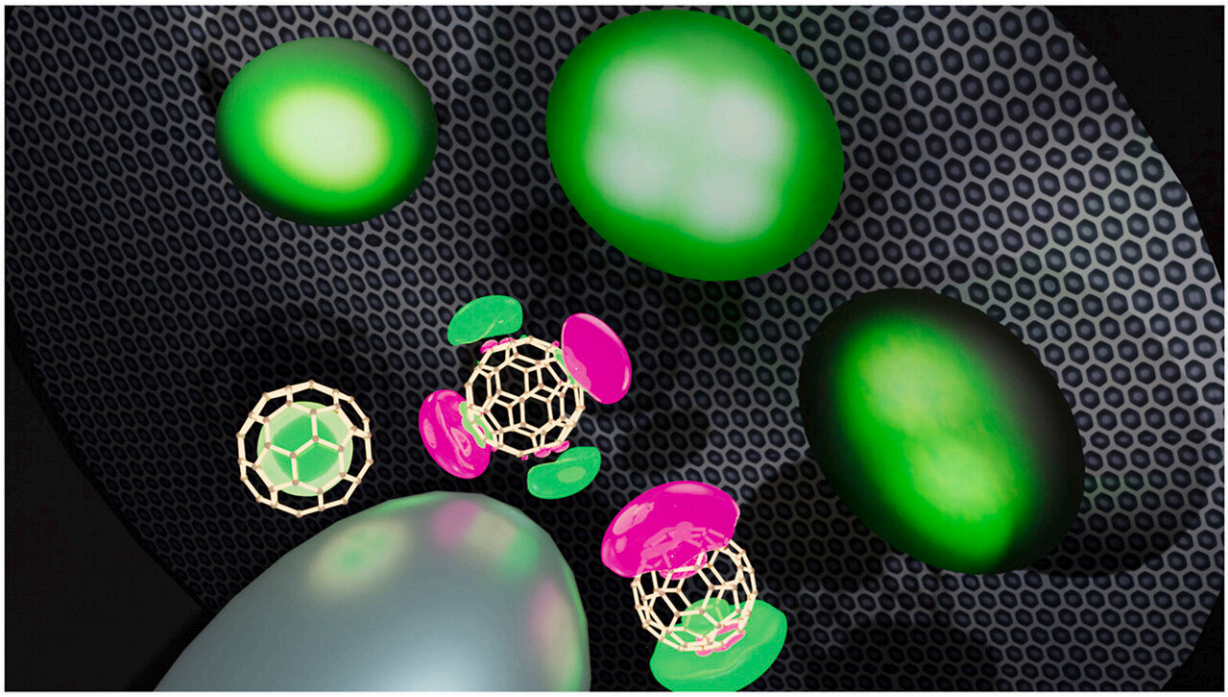

Graphical abstract. Credit: *Carbon* (2023). DOI: 10.1016/j.carbon.2023.118215

Research and development of organic electronics such as organic solar cells and organic light-emitting diodes is rapidly advancing. The "shape" of the electron orbitals of organic molecules (molecular orbitals) is crucial to the development of organic electronics; however, methods for

visualizing molecular orbitals are extremely limited.

Dynamic imaging of molecular orbitals in real space and real time has been particularly difficult yet is essential for studying structural changes and reactions of molecules.

In a new study published in the journal *Carbon*, researchers demonstrated that the particular molecular orbitals of single molecules can be imaged by projecting the electrons emitted from organic semiconductor molecules adsorbed on a needle tip. This imaging technique is called "field emission microscopy."

The field emission from a molecule and its spatial distribution were analyzed in detail, revealing that the visualized orbitals might spatially extend beyond the molecule. Such orbitals, called superatom molecular orbitals (SAMOs), are suitable for electron transport in organic electronics.

These detailed measurements of SAMOs are the results of ongoing efforts by the research group. This achievement will not only facilitate future SAMO research but also promises a new dynamic method for imaging the diffusion and reactions of single molecules on surfaces.

More information: Yoichi Yamada et al, Field emission angular distribution from single molecules, *Carbon* (2023). DOI: 10.1016/j.carbon.2023.118215

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