Electron Transfer at the Solid/Gas Interface

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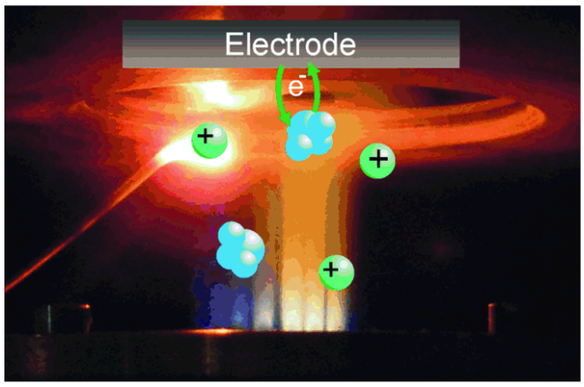
We demonstrate the ability to control redox reactions at the solid/gas interface, by considering gaseous flame plasma as an electrolyte. An innovative method to perform potentio-dynamic experiments in a liquid-free electrochemical system using flame plasma is described. Our novel approach can help apply the well-established foundations of electrochemistry developed almost exclusively in liquids, to the new context of gas plasma.[1]

Successful electrochemical measurements at the solid/gas interface are demonstrated by doping the flame plasma with organic species, and recording distinct faradaic peaks at defined potentials in cyclic voltammograms. We reinforce the sensitivity of our system by distinguishing between several amino acids, pinpointing specific functional groups. The most significant innovation that made these measurements possible was the development of a reference electrode that is able to function at temperatures over 1300 K.[2] Extensive assessment of several materials has enabled the development and optimisation of a reference electrode that has allowed us to further extend the potential window.[3] After careful experimentation and appropriate control experiments, we conclude that the features observed are precise reduction processes at the solid/gas interface. We discuss the physical origin of these electrochemical signals measured in flame plasma and provide a framework of interpretation upon which a full mechanistic understanding can be based.



Liquid-free electrochemistry presents access to a plethora of redox reactions, which lie outside potential limits defined by a liquid. The prospect of new redox chemistries will enable new technological applications such as electrodeposition, electroanalysis and astrochemistry, which will have significant economic and environmental benefits.[4]

References

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