Applications of Electron Paramagnetic Resonance Spectroscopy for Interrogating Catalytic Systems

Krzysztof Kruczała,[a]* Radim Beranek[b], Szymon Wierzbicki[a]
[a]Faculty of Chemistry, Jagiellonian University, Gronostajowa 2, 30-387 Kraków, Poland
[b]Institute of Electrochemistry, Ulm University, Albert -Einstein-Allee 47, 89069 Ulm, Germany
krzysztof.kruczala@uj.edu.pl

Electron paramagnetic resonance (EPR) spectroscopy is a powerful tool to study species bearing unpaired electrons such as reactive oxygen species (ROS), adsorbed radical anions, defect and redox metal centers, which are often involved in catalytic reactions. EPR can provide information on the identity, chemical composition, and even the dynamics of the centers themselves, thereby helping to elucidate the involvement of the radicals in the reaction cycles. In this presentation, a few examples of the applications of EPR to investigate heterogeneous catalytic systems will be provided. The in situ measurements performed with a micro-AEMFC placed in the EPR spectrometer cavity allowed for the detection of ·OOH and ·OH radicals on the cathode, and ·H ones on the anode side. The presence of such radicals indicates that ROS play an important role in the degradation mechanism of the anion conducting polymers. In the case of photocatalysts, it was possible to determine VO^{2+} and Cu^{2+} ions' location in the TiO_2 matrix and follow the evolution of the redox center during the catalytic reactions. EPR measurements revealed that both cocatalysts enhance the catalysts' activity, however, the mechanism of the enhancement is different in both cases.

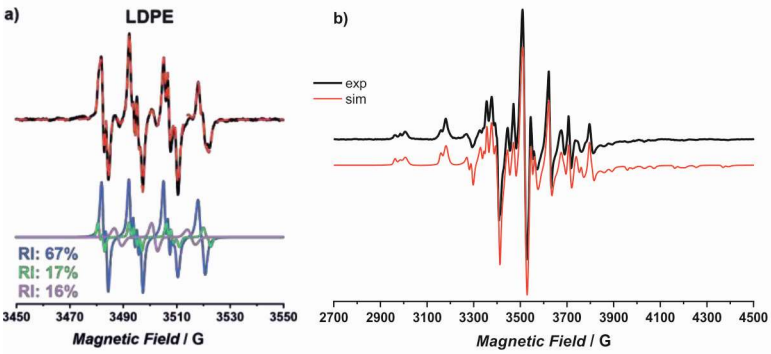

Figure 1. EPR spectra of DMPO-adducts recorded during operation of m-FC (a) and vanadyl centers in photocatalyst.

References

[1] S. Wierzbicki, J.C. Douglin, A. Kostuch, D.R. Dekel, K. Kruczała, Are Radicals Formed During Anion-Exchange Membrane Fuel Cell Operation?, J. Phys. Chem. Lett., **2020**, 11, 7630

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