

## Operando characterization of catalysts through use of a portable microreactor

To provide new understandings of the mechanisms of catalytic reactions, improved methods are needed that can monitor changes in the electronic, structural and chemical properties of catalysts, doing so in the operando conditions in which catalysts work. We describe here a microreactor-based approach that integrates the capabilities of advanced x-ray, electron, optical and gas-phase compositional analysis techniques in operando conditions. For several exemplary catalytic systems, we demonstrate how this approach enables characterization of three major factors contributing to structure-property correlations evidenced in heterogeneously catalysed reactions, namely: the atomic structure and elemental compositions of nanocatalysts; the physicochemical properties of the support and catalyst-support interfaces; and the gas and surface-phase chemistry occurring under operando conditions. We highlight the generality of the approach as well as outline opportunities for future developments

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