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Oxygen Storage Capacity of Platinum Three-Way Catalyst

A three-way catalyst (TWC) converts the primary pollutants in exhaust gas from automobiles into carbon dioxide, water and nitrogen. The highest conversion efficiency can be achieved by maintaining a stoichiometric composition at the TWC. TWCs contain material which store and release oxygen (O2) to aid this process. The O2 storage/release capacity (OSC) of a TWC is a measure of its ability to reduce the negative effects of rich/lean oscillations in the exhaust gas composition by regulating the O2 partial pressure via the O2 storage material through its redox couple. Ceria-zirconia, which has oxygen vacancies, is frequently used as the O2 storage component.

The OSC of a material can be measured by alternately pulsing a reducing agent (carbon monoxide (CO) or hydrogen (H2)) and O2 over the sample. The O2 buffering capacity (OBC) is measured by pulsing O2 in an inert gas, imitating mild reducing and oxidising conditions.

Now a team of scientists from the Università di Trieste, Italy and Universidad de Cádiz, Spain, have measured the OSC of a 0.58 wt.% Pr/Ce0.9Zr0.1O2 catalyst at room temperature – where the creation of vacancies is unlikely (N. Hickey, P. Fornasier, J. Katpar, M. Graziani, G. Blanco and S. Bernal, Chem. Commun., 2000, (5), 357–358). A feed stream was oscillated between reducing and oxidising conditions, using H2 or CO as reducing agents. When H2 was used significant dynamic-OSC values were measured at room temperature even on a redox-aged sample. This was not observed with CO as a reductant or when the OBC method was used. Spillover of H seems to be a dominant factor contributing to the effectiveness of the H2-OSC. Reduced Pt was required to promote H2 activation.