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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 (O_2) to aid this process. The O_2 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 O_2 partial pressure via the O_2 storage material through its redox couple. Ceria-zirconia, which has oxygen vacancies, is frequently used as the O_2 storage component.

The OSC of a material can be measured by alternately pulsing a reducing agent (carbon monoxide (CO) or hydrogen (H_2)) and O_2 over the sample. The O_2 buffering capacity (OBC) is measured by pulsing O_2 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.% $Pt/Ce_{0.68}Zr_{0.32}O_2$ catalyst at room temperature – where the creation of vacancies is unlikely (N. Hickey, P. Fornasiero, J. Kašpar, M. Graziani, G. Blanco and S. Bernal, *Chem. Commun.*, 2000, (5), 357–358). A feed stream was oscillated between reducing and oxidating conditions, using H_2 or CO as reducing agents. When H_2 was used significant dynamic-OSC values were measured at room temperature even on a redox-aged sample. This was not observed with CO as reductant or when the OBC method was used. Spillover of H seems to be a dominant factor contributing to the effectiveness of the H_2-OSC. Reduced Pt was required to promote H_2 activation.