DIPARTIMENTO DI CHIMICA INDUSTRIALE « TOSO MONTANARI »

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Tecniche spettroscopiche avanzate per lo studio e il design di catalizzatori di riduzione delle emissioni inquinanti dei motori a combustione interna

In situ and *operando* IR spectroscopy for the enhancement of car exhaust treatment catalysts

The major source of air contaminants comes from the combustion processes, where the transport sector lies at a prominent position, notably in urban areas. Car manufacturers are pushed, by severe regulations, economic and environmental concerns, to decrease the impact of the exhaust gases and the fuel consumption, and as a consequence lean-burn engines have been developed. If they have been conceived for lowering CO, CO_2 and unburnt hydrocarbon emissions, NOx production remains still too high. Therefore, different strategies are under development to reduce NOx emissions, relying on NSR and SCR catalytic processes, essentially. These technologies are still immature and require significant improvements before fitting in the incoming severe regulations. For these purposes new classes of heterogeneous catalysts are designed relying on the accurate investigation and modelling of the existing devices, through the use of advanced spectroscopic techniques.

In the present case, several examples will be discussed about the use of *in situ* and *operando* IR spectroscopy to investigate complex mixed oxides for NOx storage and reduction, as well as porous, zeolitic materials for ammonia selective catalytic reduction of noxious mixtures. Starting from the analysis of simple, model formulations, it is possible to describe the fundamental steps of the catalytic reactions, identifying the active sites and the main reaction intermediates. Then the quantitative and time-resolved investigation is extended to industrial catalysts, shaped in their final form and submitted to a gas mixture representative of relevant application conditions, with the aim to extrapolate the behavior of the material under duty. Thanks to these information, a new generation of highly efficient and durable catalytic materials is going to be reformulated.

However, basing on a different approach, it is also possible to formulate totally new materials presenting unprecedented catalytic properties.