# SYNTHESIS OF NANOSTRUCTURED MnO$_x$ FOR LOW-TEMPERATURE NO$_x$SCR

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Nitrogen oxides (NO, N$_2$O and NO$_2$) are by-produced and emitted in high-temperature combustion of stationary and mobile sources and constitute well-known atmospheric pollutants that can contribute to the ozone depletion, acids rains, photochemical smog and greenhouse effects.

In large stationary applications (power plants, chemical industry, etc.), the issue of NO$_x$removal is accomplished through the post-treatment of the exhaust gases by means of the selective catalytic reduction (SCR) method. Such a technology should be now revised to perform the abatement on nitrogen oxides in mobile sources too, since especially for diesel engines no solution seems to be viablewith non-specific reductants (CO, HCs), with the consequent necessity to develop active catalysts for the reduction of NO$_x$ with NH$_3$ in a significantly lower temperature range.

In the present work, the properties ofmanganese oxide (MnO$_x$) based catalysts have been deeply investigated, because manganese arouses a great research interest in low temperature SCR, but the exact nature of active sites seems not to have been clarified, neither the optimal oxidation state of the metal for the reaction has been assessed.

The synthesis of the MnO$_x$ catalysts was carried out through the Solution Combustion Synthesis (SCS) method, that was demonstrated to be effective in the achievement of nanostructured catalysts with high specific surface area [1,2]. The method is based on an exothermic oxidation-reduction reaction between suitable amounts of a salt of the desired metal oxide and an organic combustible, in this case manganese nitrate and glycine.

A series of characterization analyses have been carried out over different MnO$_x$ samples, prepared with the aim of having pure oxides phases or at least a variable distribution of the oxidation state of Mn. The structural characterization by X-ray diffraction (XRD)showed, for all samples, peaks belonging to the Mn$_2$O$_3$ phase, that resulted narrower and sharper by increasing the synthesis temperature, meaning an increased crystallinity of the catalysts.

The morphological characterization, performed by FESEM observations, is represented in the Figure below. The catalysts showed the presence of primary nanoparticles, with size of about 20 nm (see Figure on the right), disposed into large agglomerates characterized by a significant amount of porosity, with pore dimension in the range between 20 and 100 nm. The value of specific surface area of the samples, measured by the BET method, was 64.5 m$^2$/g.
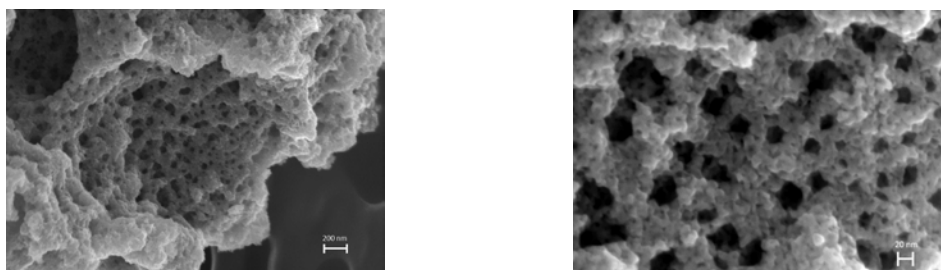


Moreover, TPR analyses have carried out over all samples and put in connection with the results of catalytic activity tests for the SCR reaction with ammonia.

References.
[1] Mescia, D., Caroca, J.C., Russo, N., Labhsetwar, N., Fino, D., Saracco, G., Specchia, V. (2008): *Catal. Today,* **137**, 300-305;
[2] Russo, N., Fino, D., Saracco, G., Specchia, V. (2006): *Catal. Today,* **117**, 214–219.