Plasma and catalyst for the oxidation of NOx - DTU Orbit (11/05/2019)

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Efficient exhaust gas cleaning from NO\textsubscript{x} (NO and NO\textsubscript{2}) by absorption and adsorption based methods requires the oxidation of NO. The application of non-thermal plasma is considered as a promising oxidation method but the oxidation of NO by direct plasma remains limited due to the back-reaction of NO\textsubscript{2} to NO mediated by O radicals in plasma. Indirect NO oxidation by plasma produced ozone allows to circumvent the back-reaction and further oxidize NO\textsubscript{2} to N\textsubscript{2}O\textsubscript{5} but the slow reaction rate for the latter process limits the efficiency of this process. Present paper gives an overview of the role of metal-oxide catalysts in the improvement of oxidation efficiency for both direct and indirect plasma oxidation of NO\textsubscript{x}. The plasma produced active oxygen species (O, O\textsubscript{3}) were shown to play an important role in the reactions taking place on the catalyst surfaces while the exact mechanism and extent of the effect were different for direct and indirect oxidation. In the case of direct plasma oxidation, both short and long lifetime oxygen species could reach the catalyst and participate in the oxidation of NO to NO\textsubscript{2}. The back-reaction in the plasma phase remained still important factor and limited the effect of catalyst. In the case of indirect oxidation, only ozone could reach the catalyst surface and improve the oxidation of NO\textsubscript{2} to N\textsubscript{2}O\textsubscript{5}. The effect of catalyst at different experimental conditions was quantitatively described with the aid of simple global chemical kinetic models derived for the NO\textsubscript{x} oxidation either by plasma or ozone. The models allowed to compare the effect of different catalysts and to analyze the limitations for the efficiency improvement by catalyst.

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