

# Acid activated vermiculites as catalysts biology essay

[Science](#), [Biology](#)



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Vermiculite was treated with 0.8 M solutions of hydrochloric and sulphuric acids for 2, 8, and 24 h. The obtained materials were characterized with respect to their composition (XRF), structure (XRD, FTIR, UV-vis-DRS), texture (BET), surface acidity (NH<sub>3</sub>-TPD) and catalytic properties.

Modification of vermiculite with acids significantly increased its surface area and pore volume and led to partial leaching of iron, aluminium and magnesium ions from its octahedral sheets. Efficiency of the leaching process depended on its duration and the nature of acid used. Acid treatment strongly modified the vermiculite structure leading to a distinct increase of its catalytic activity in the selective catalytic reduction of nitric oxide (SCR NO) process. In a series of the studied samples the best catalytic performance was found for vermiculite treated with sulphuric acid for 8 h.

## **Abstract**

The effect of Cs and Cu contents in Cs-Cu/ZrO<sub>2</sub> catalysts has been studied in the simultaneous abatement of NO<sub>x</sub> and carbon black (CB), used as a model of soot. Cu/ZrO<sub>2</sub> and Cs-Cu/ZrO<sub>2</sub> catalysts with a low Cs content are moderately active but show a beneficial role of NO<sub>x</sub> in CB elimination. Cs-Cu/ZrO<sub>2</sub> catalysts with high amount of cesium are the more active systems towards both CB oxidation and NO<sub>x</sub> reduction. The increase in the amount of Cs leads to the formation of a higher proportion of CuO crystallites which are active for CB oxidation. Cesium in Cs-Cu/ZrO<sub>2</sub> also acts as a promoter favouring the contact between reactants: on the first hand it increases the exchange surface between CB and the catalyst surface and on the other hand, it enhances the NO<sub>x</sub> adsorption capacity of Cs-Cu/ZrO<sub>2</sub> and the further NO<sub>x</sub> reduction. Full-size image (23 K)

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alternative oxygen reduction electrocatalyst to platinum based electrocatalysts is critical for practical use of the polymer electrolyte membrane fuel cell (PEMFC). Transition metal sulfide chalcogenides have recently been reported as a possible candidate for Pt replacement. Our work focused on chalcogenides composed of ruthenium, molybdenum, and sulfur (RuMoS). We elucidate the factors affecting electrocatalytic activity of carbon supported RuXMoYSZ catalyst. This was demonstrated through a correlation of oxygen reduction reaction (ORR) activity of the catalysts with structural changes resulting from designed changes in sulfur composition in the catalysts.

## **Abstract**

The feasibility of processing less-expensive alternative coatings to platinum aluminide was examined. Three approaches were followed: (1) enhancement of nickel-aluminide coatings by application of sol-gel derived two-phase-glass (TPG) overlayers, (2) evaluation of TPG coatings on bare IN 738LC, and (3) substitution of Pt with a less expensive platinum group metal (palladium). Accordingly, IN 738LC coupons were tested with several coatings including TPG, aluminide coatings (platinum aluminide, palladium aluminide, and conventional nickel aluminide), and TPG overlayers on the aluminide coatings. Isothermal-oxidation, cyclic-oxidation, and hot-corrosion tests were conducted at 900°C for 500 h to evaluate the coatings. The results showed that the TPG by itself provided superior protection compared to the platinum-aluminide coatings under both oxidation and hot-corrosion conditions. The TPG coating also showed promise as an overcoat on aluminide coatings.

## **Abstract**

### **Selective catalytic reduction of nitrogen monoxide by methane on zeolite catalysts in an oxygen-rich atmosphere**

Selective reduction of NO by CH<sub>4</sub> on zeolite catalysts has been studied. After an investigation of the catalytic features of various cation-exchanged zeolites, we found that Ga-ZSM-5 and In-ZSM-5 were highly active and selective for NO reduction by CH<sub>4</sub>. We also showed that this reaction was moderately promoted even by H-form ZSM-5, mordenite, and ferrierite. From the catalytic performance of Ga-and In-ZSM-5 in NO-CH<sub>4</sub>-O<sub>2</sub>, NO<sub>2</sub>-CH<sub>4</sub>-O<sub>2</sub>, and NO-O<sub>2</sub> reactions, it is concluded that the selective reduction of NO on these catalysts proceeds in two stages: (1) NO is oxidized to NO<sub>2</sub> on zeolite acid sites, (2) NO<sub>2</sub> and CH<sub>4</sub> react on gallium or indium sites. The highly selective features of Ga and In in the zeolite for the NO<sub>2</sub>-CH<sub>4</sub> reaction seem to be attributed to the coordinatively unsaturated nature of these sites which adsorb both of these reactants on the same site. Effect of water vapor on NO conversion was also investigated. It was found that Ga-ZSM-5 was strongly inhibited by steam, while In-ZSM-5 was fairly active even in the presence of 10% steam.

### **Improved NO<sub>x</sub> reduction over the staged Ag/Al<sub>2</sub>O<sub>3</sub> catalyst system**

## **Abstract**

The reaction mechanism of reducing NO<sub>x</sub> with hydrocarbons over Ag/Al<sub>2</sub>O<sub>3</sub> has been examined to improve its NO<sub>x</sub> reduction performance at lower temperatures, using ethanol and n-octane as representative hydrocarbon

reductants. Based on the results obtained at the early stages of the hydrocarbon oxidation and NO reduction, it is proposed that the partial oxidation of hydrocarbons and the oxidation of NO are the first reaction steps over Ag/Al<sub>2</sub>O<sub>3</sub>. n-Octane is broken up into smaller hydrocarbon molecules, which are then subsequently oxidized to form various aldehydes, while ethanol is also rapidly converted to acetaldehyde. At the same time, NO is oxidized effectively to NO<sub>2</sub> in the presence of reductants. These observations and additional experiments with variable amounts of Al<sub>2</sub>O<sub>3</sub> placed downstream of the Ag/Al<sub>2</sub>O<sub>3</sub> catalyst suggest that the NO reduction by hydrocarbons over Ag/Al<sub>2</sub>O<sub>3</sub> may occur via a bifunctional reaction mechanism; NO and hydrocarbons are converted into NO<sub>2</sub> and more reactive hydrocarbon species (i. e., smaller alkenes, oxygenated hydrocarbons), respectively, over the Ag sites, while N<sub>2</sub> is produced from the subsequent reactions between these intermediate species over different sites including Al<sub>2</sub>O<sub>3</sub>. The proposed bifunctional reaction mechanism offers an opportunity to improve the overall NO<sub>x</sub> reduction performance of Ag/Al<sub>2</sub>O<sub>3</sub> by optimizing individual reaction steps separately. Thus, the concept of a staged catalyst system has been examined using Ag/Al<sub>2</sub>O<sub>3</sub> for the formation of reaction intermediates, and a secondary catalyst (e. g., Al<sub>2</sub>O<sub>3</sub> or BaY) for the subsequent N<sub>2</sub> production reaction. Significant improvement in NO<sub>x</sub> reduction to N<sub>2</sub> was obtained at lower temperatures, when BaY was used as the second catalyst and ethanol was used as reductant.

## Graphical abstract

Based on the proposed bifunctional reaction mechanism, the concept of a staged catalyst system has been examined using Ag/Al<sub>2</sub>O<sub>3</sub> for oxidizing NO and hydrocarbons, and a secondary catalyst for reducing NO<sub>x</sub> with partially oxidized hydrocarbons. Significant improvement in NO<sub>x</sub> reduction to N<sub>2</sub> was obtained at lower temperatures, when BaY was used in the second layer and ethanol was used as the reductant.