NEW CATALYST FOR THE DECOMPOSITION OF NITROUS OXIDE (N2O) TO INNOCUOUS GASES

PATENTED TECHNOLOGY

CONTACT DETAILS:

Research Results Transfer Office-OTRI
University of Alicante
Tel.: +34 96 590 99 59
Email: areaempresas@ua.es
http://innoua.ua.es

ABSTRACT

The research team "Carbon materials and environment" at the Department of Inorganic Chemistry at University of Alicante has developed a novel, active, effective and long-term stable catalytic system for removing and/or reducing nitrous oxide by direct decomposition to harmless products (oxygen and nitrogen). This catalytic system is useful for complex waste gases coming from industries, combustion plants or vehicles exhaust gases (petroleum or diesel engines). It is characterized by allowing the treatment of diluted N2O streams (500-5000 mg/L) at low temperatures (< 525°C), even in the presence of inhibiting gases (O2, NOx, H2O, etc.). It has been successfully tested in a nitric acid plant.

The research team is looking for companies interested in acquiring this technology for its commercial exploitation.

INTRODUCTION

There exist numerous catalysts for decomposing N2O. Unfortunately, most of them have been studied at laboratory scale employing a N2O stream diluted in an inert gas. Although, the most common situation is finding N2O with a mixture of gases (N2O, O2, NOx, H2O, etc) which inhibit importantly the catalyst, avoiding its implementation at industrial scale.

Nitrous oxide (N2O) is an environmentally harmful gaseous compound. N2O is a greenhouse gas with tremendous global warming potential. It also causes ozone depletion. N2O emissions mainly come from:

- Nitric and adipic acid manufacturing plants
- Biomass combustion
- Fossil fuels
- Agricultural soil management
- Exhaust gases from vehicles

N2O concentration in the atmosphere is increasing by an average of 0,2% per year. Accordingly, the development of adequate methods for their removal and/or their controlled emission have become global imperatives. The currently used methods consist of the decomposition of N2O to molecular oxygen (O2) and nitrogen (N2). The main drawback of this procedure is the high temperatures needed (more than 625°C) so that a spontaneous decomposition takes place. However, a molecule could be decomposed at lower temperatures by using an appropriate catalyst.

TECHNICAL DESCRIPTION

For the above reasons, a Spanish research group has developed a new, active, effective and long-term stable catalytic system able to directly decompose N2O stemming from any pollutant source to non-hazardous O2 and N2 under conditions of oxidant atmosphere and temperatures equal to or higher than 450ºC (even if other inhibiting gases are present).

This catalytic system is composed of:

a) An active phase: rhodium (Rh) supported on a cerium-other(s) metal(s) mixed oxide. The amount of Rh depends on the application of the catalytic system.

b) A physical support: inorganic materials such as pellets, silica or aluminium particles, cordierite honeycomb monoliths, etc.

The procedure for the preparation of this novel catalytic system comprises the following phases:

1) The selected support is impregnated with a solution containing a cerium and other(s) metallic(s) salts.
2) Drying.
3) Calcination.
4) The mixed oxide previously supported is then impregnated with an aqueous solution of a Rh salt.
5) Drying.
6) Calcination.

It is worth mentioning that the reduction of the noble metal is not necessary when preparing this catalytic system.

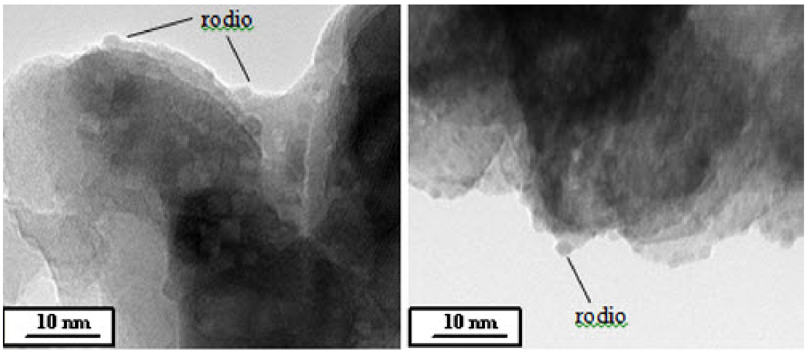
ADVANTAGES AND INNOVATIVE ASPECTS

The main advantages of this technology are:

• New, active, effective and stable catalytic system in real operating conditions at industrial scale.

• Their activity remained constant over time irrespective of the working conditions employed.

• Apart from the catalytic activity, other physical-chemical properties (crystalline structure of the mixed oxide, catalyst surface area, Rh particles size and Rh oxidation state) also kept nearly constant after more than 40 non-consecutive hours of catalytic assays in real operating conditions in a nitric acid manufacturing plant.



Images taken using transmission electron microscopy. Left: Fresh catalyst; Right: Catalyst used during 40 non-consecutive hours in a N2O decomposition assay in a nitric acid manufacturing plant. As it can be observed, the rhodium particles size (approximately 1-2 nm) is not modified during the assay.

The main innovative aspect of this invention in comparison with the commonly used for these purposes is its ability for working at oxidant atmosphere in presence of inhibiting gases (such us O2, NOx y H2O) at 300ºC or higher temperatures.

CURRENT STATE OF DEVELOPMENT

This technology is fully developed and tested at industrial scale in a nitric acid manufacturing plant where the gas steam contains N2O, O2, N2, NOx and H2O.

MARKET APPLICATIONS

This invention refers to a novel, effective, active and stable catalytic system able to remove N2O by direct decomposition to O2 and N2 in complex waste gases such us:

• Chemicals manufacturing plants (Nitric acid, adipic acid, caprolactam, acrylonitrile, glyoxal, etc.).

• Processes in which nitric acid or ammonia are used as oxidant agent.

• Combustion processes of fossil fuels (carbon, biomass, wastes, etc).

- Vehicles emissions (petrol engines, diesel engines, etc.)
- Others.

These kinds of effluents are characterized by containing a low N_2O concentration (between 500-500 mg/L) at temperatures less than 525ºC and in the presence of inhibiting gases (O_2, NO_x, H_2O...).

COLLABORATION SOUGHT

The research group is looking for companies interested in acquiring this technology for its commercial exploitation.

INTELLECTUAL PROPERTY RIGHTS

This technology is protected by patent:

- Application number: P200901897.
- Application date: 23/09/2009.

MARKET APPLICATION (4)

Pollution and Environmental Impact
Materials and Nanotechnology
Chemical Technology
Transport and Automotive