A Study of New Concept Marine SCR Catalyst with 3D Metal Structure corresponding to IMO Tier III

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To reduce the environmental pollution by Nitrogen Oxide(NO_x), International Maritime Organization(IMO) announced emission regulation Tier III, which will enter into force the 1st of Jan. 2016, for shipping exhaust gas in Emission Control Area(ECA). To meet the requirement of regulation Tier III, Selective Catalytic Reduction(SCR) process using NH_3 as reducing agent is the most commercial De-NO_x system. The representative catalyst for SCR is V_2O_5/TiO_2, which is the choice for marine applications[1-2].

Commercial SCR catalyst with honeycomb form has been generally installed in SCR reactor inside marine vessel engine. The characteristics of SCR catalyst with honeycomb form are low strength, easy to destroy at high outlet velocity of exhaust gas from the marine vessel. The efficiency of catalyst, therefore, could be reduced as these catalytic properties. In addition, from an economic aspect, vanadium is expensive material, which is buried in specific areas.

The purpose of this study is to supplement the defects of Oxide Honeycomb Catalyst(OHC) like the low strength and excess use of expensive active material in SCR process.

For these reasons, We designed to Metal Honeycomb Catalyst(MHC) as new concept for applying marine SCR system. The MHC has many advantages such as compactness, lightness, thermal stability etc.

As shown Fig. 1, TiO_2 nanotube(TONTs) arrays made a synthesis by anodizing process on the surface of titanium honeycomb form. After that, V_2O_5 as active metal is coated as a monolith on the TONTs via wash-coat method. Finally, we obtained the new concept MHC with 3D metal structure to apply SCR catalyst for marine.

To perform in a closely real condition, the mixed gas which was similar with a marine vessel exhaust gas reacted with NH_3 to reduce NO_x using the produced catalyst. Conversion of NO_x could be calculated by measuring the concentration of NO_x in inlet and outlet of reactor. Wear-resistance test performed with injecting 220 mesh SiO_2 powder on 40 m/s during 30 min to the catalyst. The results of conversion of NO_x at 250 ~ 400 ^oC and of wear resistance were in Fig. 2. The conversion of NO_x of both OHC and MHC was similar at each temperature. The weight change of MHC is very lower than OHC from the result of the wear resistance test.

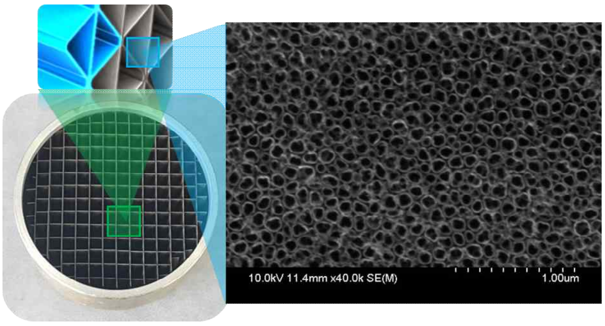

Fig. 1 SEM image of TiO_2 nanotube on MHC grown by anodizing process.

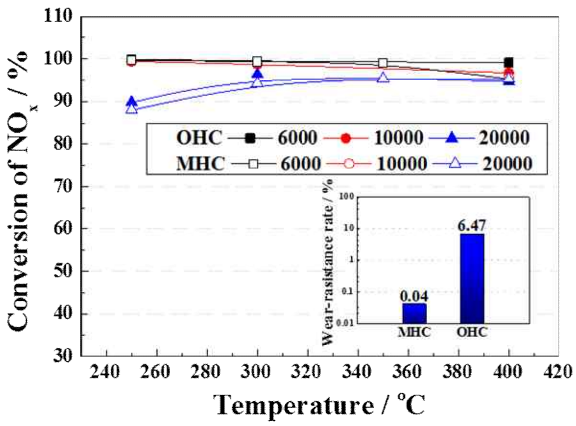

Fig. 2 Conversion of NO_x and wear-resistance rate over MHC and OHC.

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