Development of Recovery and Removal Techniques of Dilute Reactive Nitrogen to Realize Nitrogen Circulating Society

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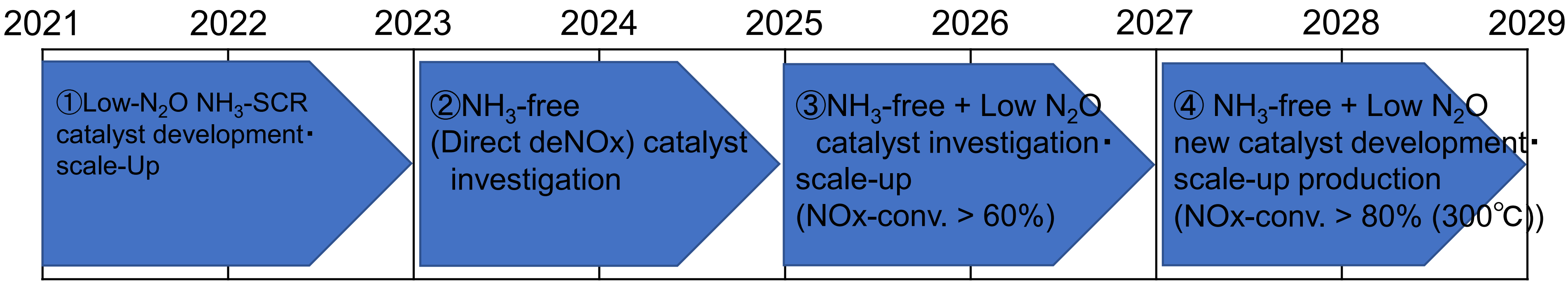
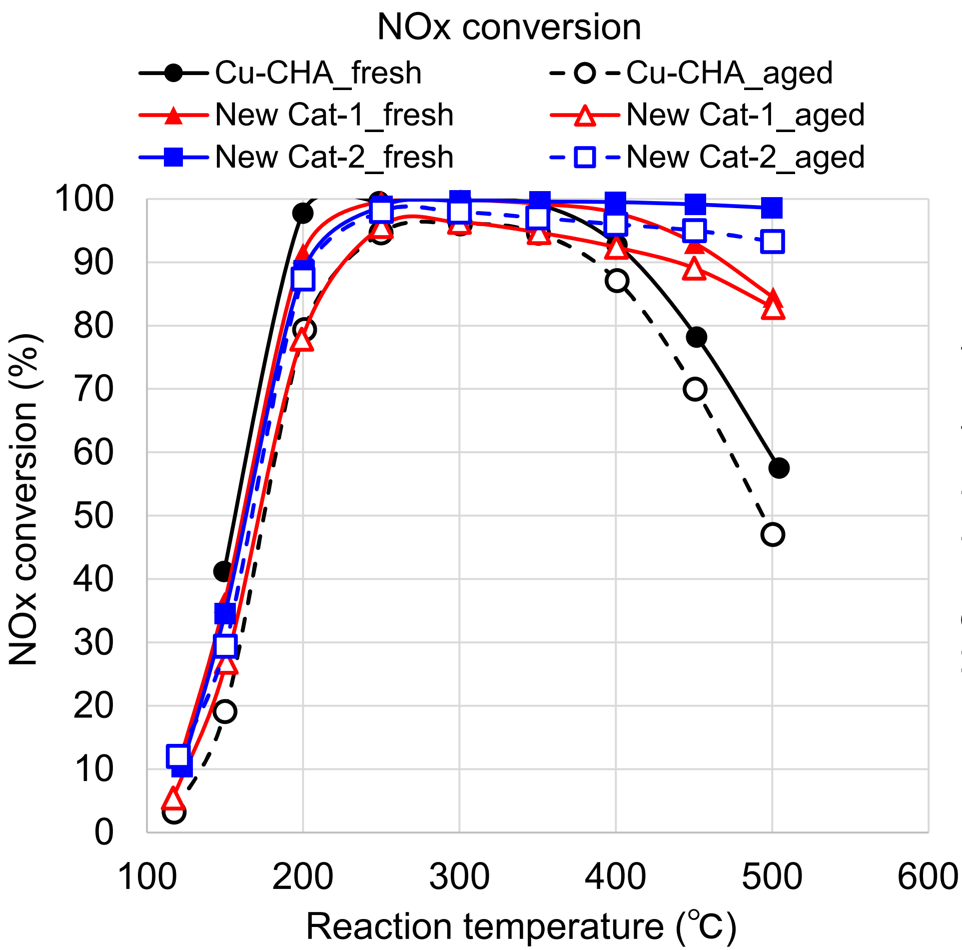
Overview

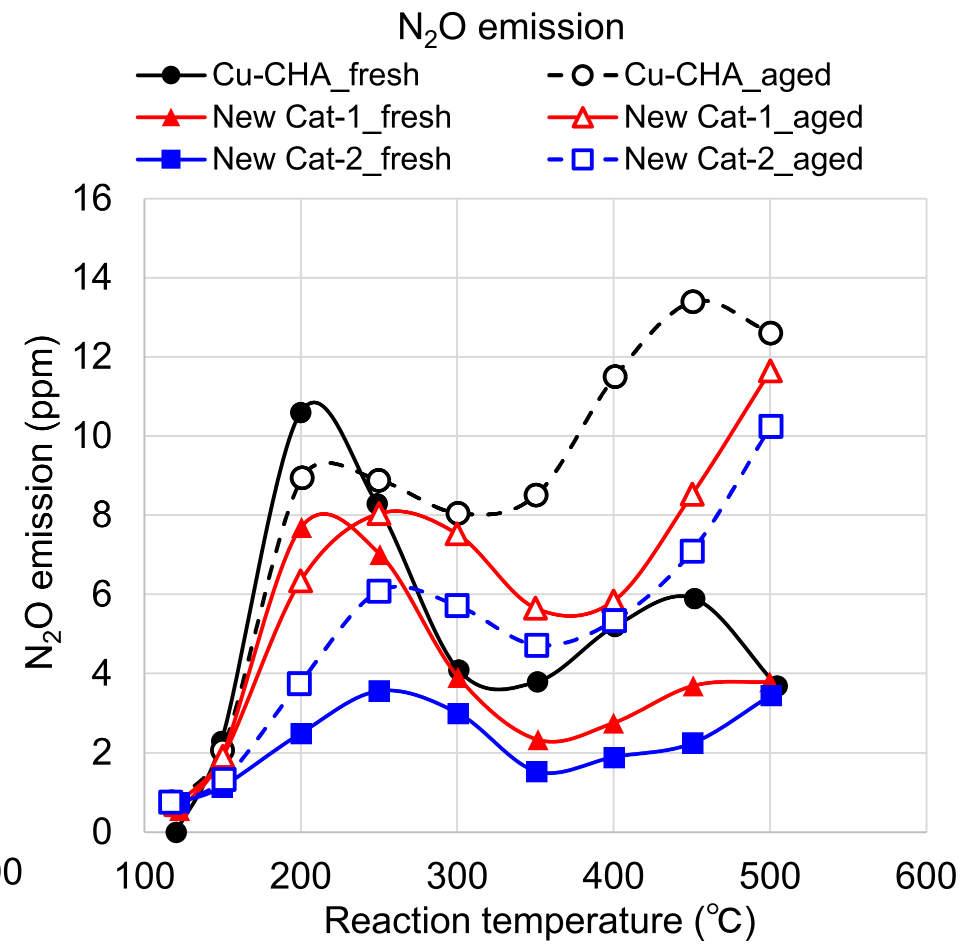


Development items / contents	・Further sophistication of the process of removing NOx emitted from internal combustion engines. ・Search and narrow down new exhaust gas catalyst candidate zeolites. ・Scale-up production of zeolite catalyst. ・Pilot demonstration of NOx decomposition catalyst.
Final goal (FY2029)	・Practical realization of a revolutionary new exhaust gas catalyst that does not use NH_3 and precious metals, which enables driving under combustion conditions (lean burn engine, etc.) that greatly improves the fuel efficiency of internal combustion engine vehicles and drastically reduces CO_2 emissions. （NH_3-free, conversion of 80% or more at 300ºC, N_2O emission is 1/10 or less of the current SCR catalyst）
FY2022 target	・To develop a new exhaust gas catalyst capable of high durability and low N_2O emission in NH_3-SCR at the laboratory level. (A new NH_3-SCR catalyst that has durability at 800 ºC and emits 1/2 of the current exhaust gas catalyst (Cu / CHA) with N_2O emissions.)
Current achievements	・The newly developed zeolite catalysts showed NOx decomposition performance superior to the current catalyst (Cu-CHA) before and after the durability test at 800ºC in the NH_3-SCR reaction. ・The N_2O emission of the catalyst was about half that of the current catalyst (Cu-CHA).

Comparison of NOx purification performance and N_2O emissions of the current catalyst (Cu-CHA) and the new catalyst.

Aging condition : H_2O-10vol%、SV = 3000 h^{-1}、800℃、5h
Reaction condition : SV = 200000 h^{-1}, input NOx = 350 ppm, NH_3 = 385 ppm, O_2 = 14 vol%, H_2O = 5vol%、Catalyst pellet size : 600~1000 *μ*m





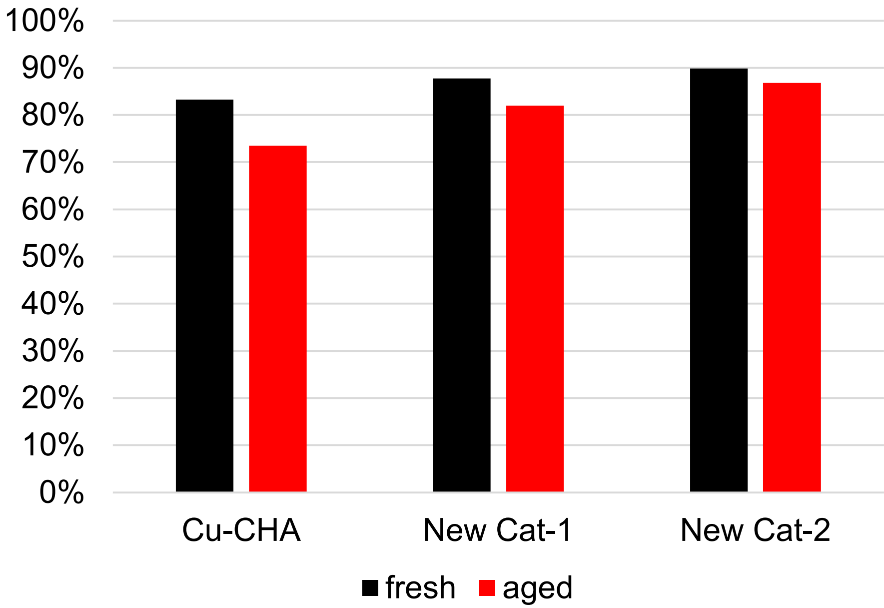
・Before and after steam treatment, new zeolite catalysts had high NOx purification performance and low N_2O emissions. 。

Comparison of Average NOx purification performance and N_2O emissions of the current catalyst (Cu-CHA) and the new catalyst.

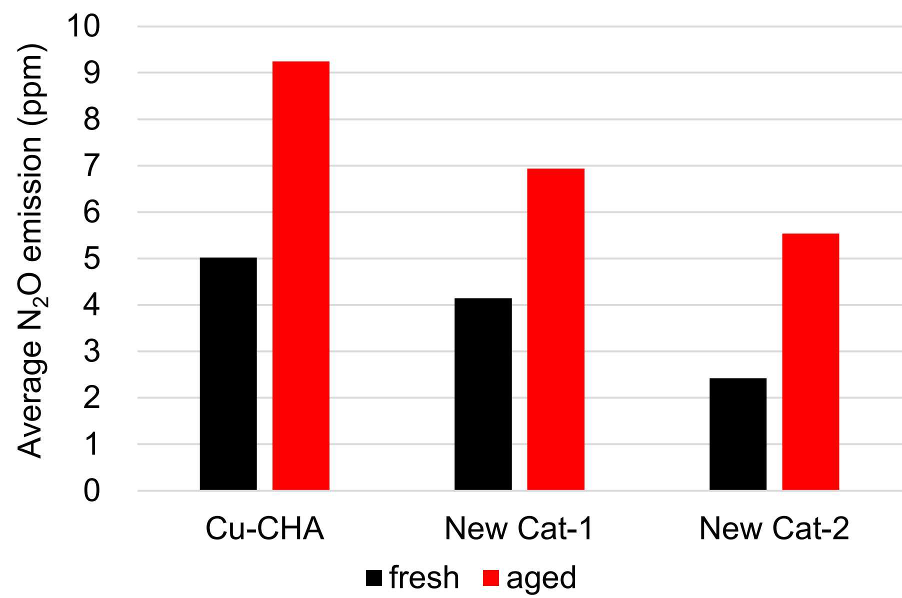
	Average NOx conversion (150 – 500ºC)	
	fresh	aged
Cu-CHA	83%	74%
New Cat-1	88%	82%
New Cat-2	90%	87%

	Average N_2O emission (150 – 500ºC)	
	fresh	aged
Cu-CHA	5.0 ppm	9.2 ppm
New Cat-1	4.1 ppm	6.9 ppm
New Cat-2	2.4 ppm	5.5 ppm

Average NOx conversion (150 - 500ºC)



Average N_2O emission (150-500℃)



・In the NH_3-SCR reaction, the new zeolite catalyst showed NOx decomposition performance superior to that of the current catalyst (Cu-CHA) before and after the durability test at 800 ºC.

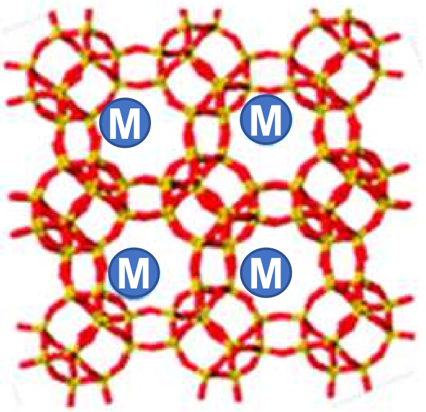
・The N_2O emission of this catalyst was less than 1/2 that of the current catalyst (Cu-CHA), but it was slightly higher than 1/2 after the durability test, so further improvement of durability will be an issue in the future.

Future plans

▪Further lower N_2O emissions.
→ Optimization of Metal loading amount + Examination of combinations of metal elements that have the effect of reducing N_2O

▪Scale-up of new catalysts
→ 100 L scale synthesis of new zeolite catalysts.

▪ Search for promising catalyst candidates for direct deNOx reaction
→ Focusing on the zeolite structure that showed high performance in the NH_3-SCR reaction, we will investigate the supported metal species that will be the active centers, and search for a new zeolite catalysts that can decompose NOx even under NH_3-free conditions.
→ Precise control of the coordination structure of the active metal in the zeolite pore space seems to be the point. In cooperation with JFCC and AIST, we aim to establish a method for precisely analyzing the structure around active metals and constructing active sites that are effective for direct deNOx.



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