

# Effect of Fabrication Parameters on CO Oxidation Characteristics of Three-Way Catalyst Microparticles Membrane on Gasoline Particulate Filter

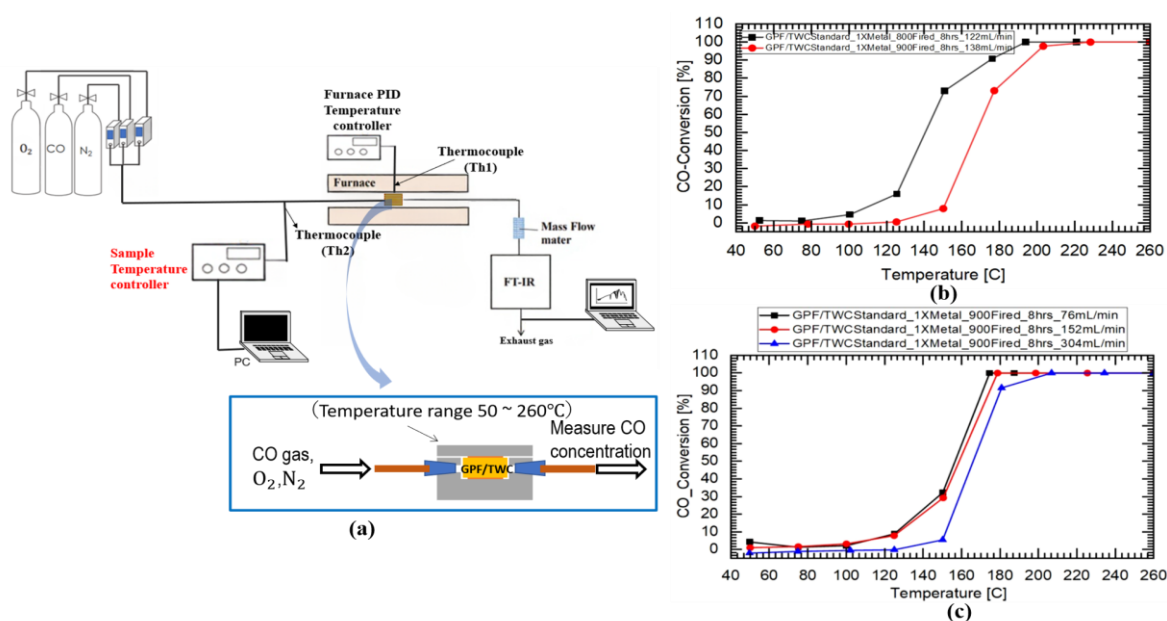
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**KEY WORDS:** Exhaust aftertreatment system, Gasoline particulate filter, Three-way catalyst, Membrane particulate filter, CO oxidation, Light-off temperature (A1)

Efforts in the transportation sector toward carbon neutrality are advancing with fully electric vehicles, fuel cell vehicles, and hydrogen combustion internal combustion engines, moving toward approaches that avoid direct carbon combustion. Despite these advancements, to achieve near-zero emissions in aftertreatment without requiring additional energy, beyond enhancing purification capabilities at low temperatures, there is therefore a need to control of chemical species behavior. In this study, a multilayer TWC particle membrane was developed on a miniature cordierite gasoline particulate filter (GPF) to provide integrated three-way catalytic (TWC) and particulate filtration functionality. The study investigated the effects of membrane fabrication conditions and CO oxidation performance. TWC particles were generated using an ultrasonic spray technique and thermally treated in an electric furnace at 700 °C before deposition onto the GPF wall. A two-step firing process was employed to improve membrane adhesion and mechanical strength. The first firing was conducted during particle deposition at 800–900 °C for 4 h, followed by a second firing after additional particle deposition. The fabricated TWC/GPF samples exhibited an increase in pressure drop after catalyst deposition, reflecting the additional flow resistance introduced by the deposited particle membrane. CO oxidation experiments were conducted to evaluate the catalytic performance of the TWC/GPF under different firing temperatures and gas flow rates as shown in Fig.1(a). Increasing the firing temperature from 800 to 900 °C shifted both the light-off and full-conversion temperatures toward higher values. In particular, The experimental results showed that the full-conversion temperature increased from approximately 194 °C to 228 °C, the  $T_{50}$  increased from approximately 141 °C to 168 °C while the  $T_{20}$  increased from approximately 127 °C to 155 °C as illustrated in Fig.1(b). These results indicate a decrease in apparent CO oxidation activity with increasing firing temperature, which may be associated with thermally induced changes in catalyst microstructure, active-site accessibility, or the interaction between the catalytic components. A similar trend was observed with increasing gas flow rate. The CO conversion curves shifted toward higher temperatures as the flow rate increased, indicating a reduction in apparent catalytic activity under higher-flow conditions as shown in Fig.1(c). This behavior can primarily be attributed to the short contact time between the gas and the catalyst involved in the three total flow rate loadings as the flow rate increase. Despite, the decline in catalyst activity performance for both firing temperatures and flowrates changes, optimization of the catalyst performance and strength of membrane TWC/GPFs membrane filters support rational microstructural design aimed at reducing pressure losses and enhanced low-temperature catalytic performance for next-generation gasoline aftertreatment systems and future emission regulations.



**Fig. 1:**(a) CO Reaction Experiment set up, (b) Effect of sintering temperature and (c) Flowrate on CO conversion performance