A Novel Method of Fast Removal of Pollutants from Vehicle Emissions during Cold-start

Wang, Ran

Vehicle exhaust is one of the major pollution sources. An efficient method of emission control is to convert exhaust pollutants to less harmful substances by the catalyst placed in the exhaust pipe. However, a large portion of pollutants emission occurs in the initial 2-3 minutes of engine cold-start before the catalyst reaches its operating temperature (typically above 300 oC). In this study, the Ce:Zr atomic ratio, Pd:Rh mass ratio and pore density of the catalyst for automotive emission control were optimized to lower its operating temperature from 400 oC to 350 oC, which is benefit to shorten the time of initializing exhaust conversion reaction. In addition, magnetic heating and electric heating were also developed to rapidly heat the catalyst. With high-frequency electrical heating, the optimized catalyst can reach 350 oC in 5 seconds, which is much faster than current techniques that need at least 20 seconds. The simulated test showed that the residual of NO and C3H8 were controlled below 0.9 ppm and 0.56 ppm respectively, and CO was completely converted. For practical application, the layers of large-volume catalyst were separated with insulated temperature-resistant material to avoid non-uniform distribution of high-frequency current. Compared with traditional techniques of cold-start, the study increased exhaust conversion efficiency by 78 %. More importantly, the project uses one catalyst to clean automobile exhausts from startup to running. But current methods need a combination of 2-3 techniques to control cold-start emissions of automobile. This new method is also may be suitable for diesel vehicle pollution control.

Awards Won: