YSZ-Based Electrochemical Sensors: from Materials Preparation to Testing in the Exhausts of an Engine Bench Test

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Abstract

New emissions regulations increase the need of reliable and inexpensive sensors for monitoring and control of automotive gas pollutants. At present, given the lack of reliable CO/hydrocarbons and NOx sensors, the On-Board Diagnostic (OBD) system is performed using electrochemical oxygen sensors that successfully work in harsh combustion exhaust environment. If modified to selectivity measure NOx or CO/hydrocarbons concentrations, this type of sensors can be used to improve the combustion as a feed-back elements in engine control systems. Planar sensors based on tape-cast YSZ layers were fabricated. Two Pt finger electrodes were deposited on one side of the layers. One of the electrodes was covered with an oxide thick film. The oxides tested included WO3, La0.8Sr0.2FeO3 and In2O3. The sensors were tested at various concentrations of NO2 and CO at different temperatures. Some field tests were performed. Planar sensors were located close to a commercial oxygen sensor, downstream the three-way catalytic converter of a FIAT fire 1242 c.c. spark ignition engine coupled to a dynamometer. The gas sensor packaging used was like a commercial lambda probe provided with heating facility. Another commercial oxygen sensor was located upstream the catalytic converter to control the air/fuel ratio (A/F) of the engine. EMF response of gas and oxygen sensors both located downstream the catalytic converter were recorded simultaneously. The performance of the gas sensors was measured at the stoichiometric point (A/F=14) at different engine regimes (RPM and torque) and thus at different operating temperatures. The response of gas sensors was compared with the response of the commercial lambda probe. Moreover the EMF measurements were related to the exhaust gas concentrations measured by spectroscopic analytical equipment at the engine exhaust end. Preliminary measurements showed promising results in terms of sensitivity, stability and reproducibility.