

Neuartiger Sensor zur Bestimmung des Zustandes eines NO_x-Speicherkatalysators

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Summary

In the thesis „Novel sensor for determining the state of a NO_x-storage catalyst“, it is investigated whether an in-situ measurement of the complex electrical impedance of the catalyst coating is an appropriate means to determine directly the catalyst status. Four key questions are addressed:

- 1.) Can such a “NSC status gauge” directly measure the degree of NO_x loading?
- 2.) Can aging processes (thermal stress, sulfur poisoning) be detected by the “NSC status gauge”?
- 3.) Can the time dependent NO_x storage and regeneration process be directly gauged?
- 4.) Can the time dependent sulfur poisoning and desulfurization process be directly gauged?

The sensor consists of interdigital electrodes that are deposited on a thin planar substrate. On the reverse side of the substrate, a heater is applied. Both sides are covered with the original catalyst coating, allowing detecting directly electrical impedance and temperature of the catalyst film.

The sensor response was investigated in three stationary conditions, namely freshly regenerated (reduced) in rich exhaust, oxidized without NO (lean), and oxidized and fully loaded (lean with NO). All stationary conditions could have been distinguished easily. It was shown by that -after calibration- the sensor is able to detect fully the absolute amount of stored NO_x. In addition, thermal aging as well as sulfurization of the catalyst film can be detected.

In order to explain the physical processes that lead to both sensor behavior and catalyst behavior, different model powders were prepared and investigated. The overall sensor behavior can be modeled using the General Effective Media Theory.

Further experiments were performed in a dynamometer test bench. Four sensors were integrated in an NSC. All results obtained from the synthetic test bench were confirmed. It could even be shown that such a set of sensors can detect the location of the loading front, the loading status, as well as the regeneration status. Sulfurization and desulfurization could be studied as well.

Zusammenfassung

Der vorliegende Beitrag zeigt, dass durch In-situ-Messungen der elektrischen Impedanz des Beschichtungsmaterials der Zustand eines NO_x-Speicherkatalysators hinsichtlich des NO_x-Beladungsgrades, des Regenerationsgrades, der Verschwefelung und der thermischen Alterung bestimmt werden kann. Weiterhin werden die physikalisch-chemischen Ursachen des Zusammenhangs zwischen Katalysatorzustand und elektrischer Impedanz ergründet und modellhaft beschrieben. Der Nachweis der Anwendbarkeit im Kraftfahrzeug wird erbracht.

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Bestellinformation / Order information

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