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Porous ceramic catalysts for micro-electromechanical systems

Keywords

Catalysis, Foams, Porous media, Sol gel, Fuel reformer, MEMS device

Summary

The patent describes a very flexible and cost-efficient method to produce a solid structured foam-type catalyst that can be filled in micro-electromechanical systems (MEMS) and nano powder catalysts produced by such a method.

Background

Good and efficient catalyst materials are often nanosized materials available in powder form. In order to use such a catalyst in a MEMS device the nano powder needs to be bound to for example a gel or a foam. So far, no method for this exists.

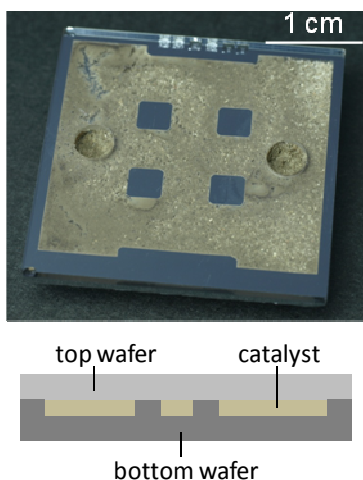


Fig. 1: Light microscope top view image of a MEMS devices filled with catalyst (top) and a schematic cross section.

Patent Status

- Patent pending

Invention

Catalyst materials are often fabricated by coating, impregnation or packing catalyst particles in a cavity. These methods are not well suitable for MEMS devices due to inhomogeneities, loose particles, and loss of materials during operation. Our invention binds the catalyst material in a solid structured foam which can be provided in situ in a final MEMS geometry (Fig. 1) without a need to transfer the rigid catalyst to the final geometry after production. The catalyst particles are mixed with a ceramic binder, a carrier liquid, at least one chemical additive for promoting dispersion and/or controlling gelation and, optionally, inert carrier particles to obtain a slurry having a gel- or paste-like consistency. By a flow method, the prepared slurry with the catalyst can be transported to a desired location which can be a small MEMS cavity. In most cases the slurry will be heated in order to obtain a rigid porous ceramic body, however no sintering is required. The performance of the catalyst is very stable over time (Fig. 2) and will enable a range of new sensor and catalysis applications.

Fig. 2: Very stable performance of the catalyst over time: butane conversion is flow rate dependent and is stable up to at least 5 h.; experiments were performed at 550 °C.

Features & Benefits

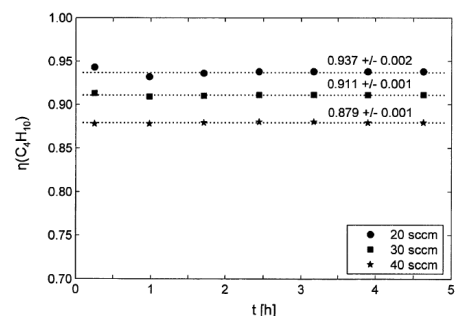
- Efficient method to place the catalyst in situ in any final reactor geometry
- Very homogenous distribution of the catalyst resulting in excellent catalytic performance (Fig. 2)
- Universal method that can be applied to many catalysts, substrates and miniaturized systems
- Easy to implement and cost-efficient method

Field of Application

- Catalysis
- Sensors
- Fuel cells
- MEMS devices
- Applications using porous materials

References

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