

## Foreword

# HDS and HDN catalysis for super-clean fuels

Environmental protection is one of the most important problems we are facing. Recently, regulations about sulfur content of oil fractions have become evermore stringent in many areas and countries. For example, in Japan, the sulfur content in gas oil has been limited to 0.2wt% since 1992. And the limitation is supposed to be less than 0.05wt% from this October. Moreover, it would become as little as 0.01wt% in the near future.

The background of these severe regulations are well known:

- (1) In big city areas air pollution by  $\text{NO}_x$ ,  $\text{SO}_x$  and particulate material has actually become serious.
- (2) The exhaust gas recirculation (EGR) mechanism for reducing  $\text{NO}_x$  from diesel engine exhaust needs a very low sulfur content (Furthermore, it should be pointed out that the amount of sulfur contained in petroleum produced every year is comparable to that of the natural sulfur cycle on the earth).

Currently, every effort for environmental protection research and development is being prompted. Espe-

cially, there has been a growing need to develop catalysts that enable deep hydrodesulfurization (HDS), hydrodenitrogenation (HDN) and also hydrogenation of aromatics (hydrodearomatization).

In the present articles, recent developments in catalysis for HDS, HDN and hydrodearomatization of oil fractions aiming at producing superclean fuels are reviewed. These include studies on reaction mechanisms, catalyst modifications, catalyst characterization, new catalyst preparations, formation of a model catalyst, and process design. In order to gain a broader view, these articles also include recent efforts in producing clean fuel from coal, which have been earnestly pursued in Japan since the two oil-shocks in 1970s, as well as from oil.

We hope these articles will contribute adequately to a step toward a new generation of HDS and HDN systems, and also to a sustainable society in the twenty-first century.

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