High Throughput Screening for Environmental Catalysis Development

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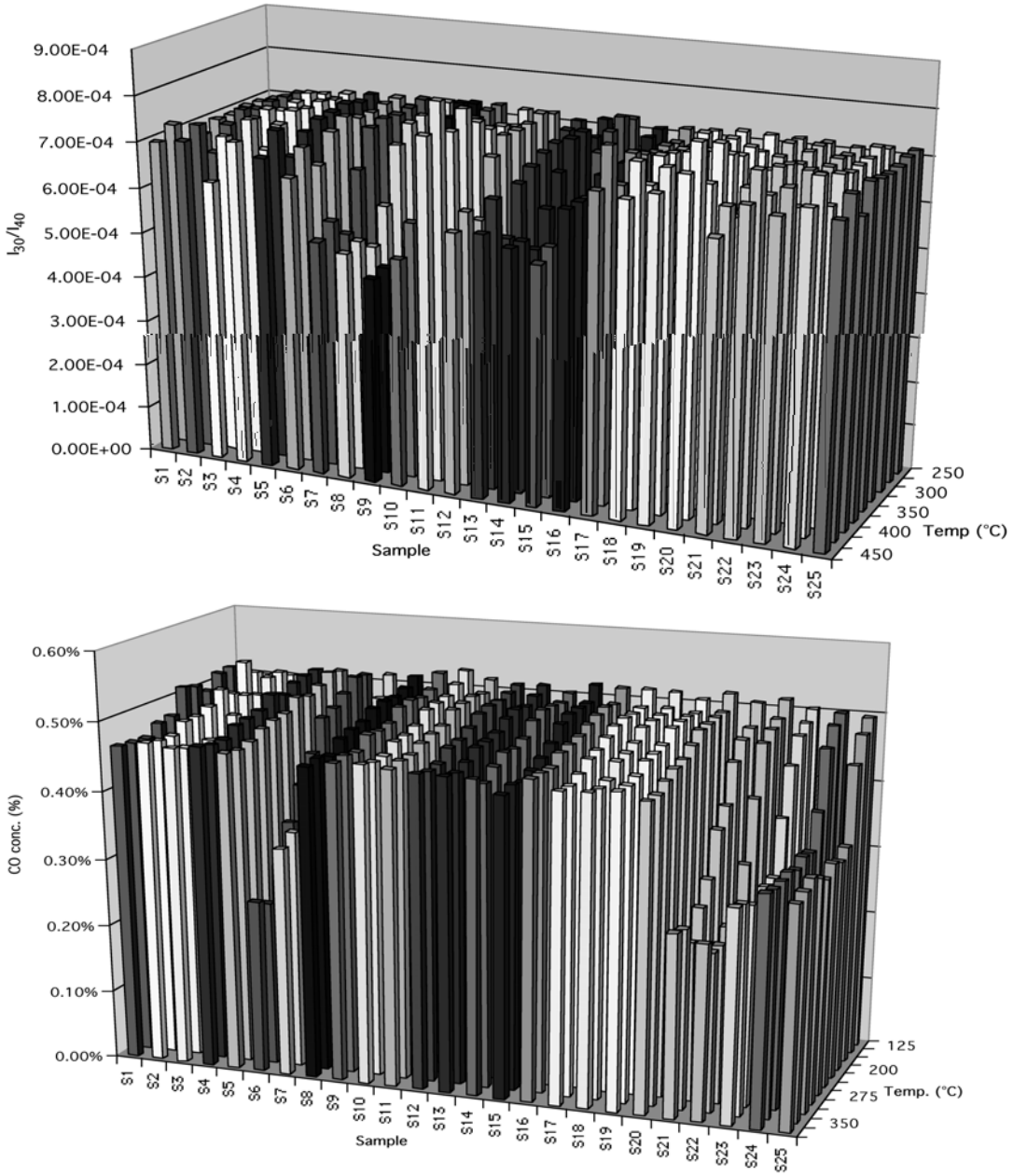
Introduction

High throughput screening (HTS) was first used by the pharmaceutical industry and has only recently been adopted by developers in the field of environmental catalysis. The HTS approach can be described as a three step process, with a feedback loop: (i) Fast preparation of catalyst samples with systematically varied properties (active material, support material, dispersion, etc.), (ii) Fast testing of the catalytic properties of the produced samples, (iii) Fast processing and evaluation of the experimental data, to be used for modification and improvements when preparing the next generation of catalyst samples. The loop is repeated until certain criteria are fulfilled and the selected materials will then be prepared in larger quantities for detailed evaluation and characterisation, using more traditional methods. Applying HTS methods for catalyst discovery and optimisation has been described in a few recent review articles [1-4].

Results and Discussion

An experimental HTS system (see schematic illustration), primarily designed for activity measurements of heterogeneous catalysts for environmental applications, has been developed [5]. It is now used in screening studies of catalysts for different applications. The catalyst samples (Ø 7mm discs) are washcoated using a spray technique and the active components are added by traditional wet impregnation. Two recent studies, using the HTS system, are direct NO_x reduction under lean conditions (e.g. for gas turbines) and selective CO oxidation in a hydrogen-rich feed gas (used as fuel for fuel-cells). The active materials in the catalysts, contained single or mixed metal oxides and noble metals. Two examples from the investigations are presented in the figures below. The first figure illustrates reduction of NO_x from a gas mixture containing 500 ppm NO + 3500 ppm CO + 15% O_2 + 5% H_2O (mass 30 measured by the mass-spectrometer, approximately the total NO_x level, is given for 25 different catalyst samples as a function of temperature). The second figure illustrates CO removal from a feed stream containing 0.5% CO + 0.3% O_2 + 4% H_2 (the CO concentration, is given for a set of 25 different catalyst samples as a function of temperature).



The activity measurements made by the HTS system demonstrate the possibility to identify the most active catalysts from a large number of samples, making it a powerful tool for catalyst development.

References

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