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SOME CHEMICAL AND STRUCTURAL INVESTIGATIONS OF THE NICKEL-URANIUM-OXYGEN SYSTEM BY TEMPERATURE-PROGRAMMED TECHNIQUES

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Nickel-doped oxides of uranium have been found to exhibit catalytic properties for a variety of gaseous reactions, for example, as steam reforming catalysts for the conversion of hydrocarbons into a fuel gas containing hydrogen, methane and oxides of carbon. Furthermore, more recent investigations have indicated their potential utility as methanation catalysts. Despite these important catalytic properties the relationship between the fundamental structural properties of the nickel-uranium oxides and their catalytic performance is far from well-defined.

The nickel-uranium oxide catalysts have been prepared by evaporation techniques whereby aqueous solutions containing the metal nitrates are reduced in volume and the residues calcined in air at temperatures between 100 and 1000 °C. The solids, which have been examined using powder X-ray diffraction to identify the phase compositions have also been investigated by temperature-programmed reduction which is a relatively new technique which has been developed over recent years for the study of materials which are in a potentially reducible condition. The technique involves monitoring the uptake of hydrogen by a material whilst it is subjected to a linearly rising temperature. The temperature-programmed reduction spectra are characteristic of the material under investigation and when used in conjunction with powder X-ray diffraction data give information which can be interpreted in terms of the structural properties of the solids.

Preliminary investigations have shown that the reduction of uranium oxides is facilitated by the presence of nickel. As the nickel concentration in these materials is increased the temperature at which the cationic species reduce are observed to decrease.

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