DIRECT CONVERSION OF METHANE TO HIGHER HYDROCARBONS THROUGH OXIDATIVE COUPLING

by

Kevin J. Smith and Terry Painter
Coal and Hydrocarbon Processing Department
Alberta Research Council
P.O. Bag 1310
Devon
Alberta, T0C 1E0

and

Jan Z. Galuszka
Energy Research Laboratories
CANMET
555 Booth St.
Ottawa
Ontario, K1A 0G1.

The Alberta Research Council and Energy, Mines and Resources, Canada (CANMET) are currently pursuing a jointly funded research program aimed at upgrading methane to higher hydrocarbons via oxidative coupling. The major objective of this work is to investigate the use of a range of supports, metal oxides and promoters as catalysts for the oxidative coupling reaction, to optimize the formulation of the most promising catalyst and to determine the effect of process variables on catalyst performance.

As part of this program, a comparitive study on the performance of Sn, Bi and Pb oxides, supported on CaO, MgO and NaY zeolite, and promoted with La, Li and K, has been performed. The catalysts were tested at 101 kPa and 750 °C in a fixed bed, quartz reactor, operated with the CH_4 and O_2 fed to the reactor in a cycling mode. The catalysts were characterized by ESCA, XRD and surface area analysis.

For the catalysts supported on CaO, the C2 yield decreased in the order Pb>Bi>Sn, with the PbO/CaO catalyst having a C2 yield of 12.3 %. For the 20% PbO supported on NaY zeolite, CaO and MgO, the C2 yield decreased in the order CaO>MgO>NaY, whereas the C2 selectivity decreased in the order NaY>CaO>MgO. It is also shown that promoting the catalysts with La, Li and K has a positive effect on C2 yield and that for the PbO/CaO system, the promoter appears to reduce the loss of PbO from the catalyst surface.

These observations are discussed in terms of the XRD, ESCA and surface area analyses and in terms of observations reported in the literature on similar catalysts. Directions of future work will also be highlighted.