Abstract:
Plasma discharges are known to facilitate the catalysis of reactive gas mixtures [Ref: 1, 2, 3 & 4]. A variety of plasmas, including surface barrier discharges, have been demonstrated to enhance the efficiency of the catalysts such as nickel/alumina or silver/alumina, used in conventional thermally activated reactions. The observed improvements have included a lowering of the onset temperature at which the catalyst becomes effective, and an increase in the overall efficiency of the process. A number of diagnostic methods have been employed to study the synergistic behaviour of plasmas and heated catalysts, the technique adopted often being specific to the monitoring of a particular reaction product. The work described here is aimed at demonstrating the versatility of mass-spectrometric methods in following the behaviour of typical plasma-assisted catalytic processes.

Experimental results:

Oxidation of carbon monoxide.
Figure 2a shows a typical mass scan for the gas sampled from the reactor when the input gas flow consisted of helium containing 0.2% of CO and 0.4% of O₂. Figure 2b shows the result of subtracting a scan taken when the plasma was off from one taken when the plasma was operating (both scans being taken at room temperature). The formation of carbon dioxide at the expense of the carbon monoxide and oxygen is clearly seen.

Dry Reformiation of Methane.
The reactor consists of a quartz tube with a tungsten electrode running through it. Quartz frit discs were used to centralise the electrode and a grounded electrode surrounding a section of the reactor tube which included the volume occupied by the powdered catalyst (refer to Figure 1). The experiments included ones with nickel/alumina and palladium/alumina catalysts.

Conclusions
The measurements illustrate the ability of the instrument to monitor the behaviour of plasma-enhanced catalytic processes. The Gas Analyser responds rapidly to any time-dependent variation in the products of the process. The relative positions of the catalyst and plasma regions of the reactor may be readily altered. Future experiments will include studies of the role of the carrier gas in determining the plasma contribution to the reaction processes.

References