

catalyst for phenylacetylene. It had high activity and produced more than 10 litres of H_2 /min/g Pd with 94.5 per cent selectivity (9). This is better than results from the same catalyst which has been produced by other methods.

Catalysts with supports such as titania and charcoal, were obtained using the same method from binary solutions of the carbonylchloride complexes of the platinum metals (platinum and palladium). Results of tests using them are shown in Table VIII. These catalysts have the same activity and selectivity as catalysts prepared by standard methods, however, their method of production is simpler.

Conclusions

Thus, the results of our investigations show that the hydrocarbonylation process and carbonyl complexes of the platinum metals can

be used for the concentration, extraction and refining of the platinum group metals. The use of these processes for the production of composite materials and processing by powder metallurgical methods offers a potentially successful alternative to current means of production. However, as yet, these methods have not been put to industrial use.

References

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Single Platinum-Rhodium Gauze for Partial Oxidation

The possibility of using a small reactor for converting the light alkanes found in remote natural gases into more useful liquid fuels and commercial products, by an efficient and fast process, has been suggested in work performed by scientists at the University of Minnesota (D. A. Goetsch and L. D. Schmidt, "Microsecond Catalytic Partial Oxidation of Alkanes", *Science*, 1996, 271, (5255), 1560–1562).

Using a single layer of woven platinum-10 per cent rhodium gauze, they were able to perform catalytic reactions of microsecond duration at atmospheric pressures with very high reaction rates. This allowed selective partial oxidation of the reactants to take place. Reacting gases were heated from room temperature to $> 800^\circ\text{C}$, on entering the single layer of gauze, for a contact time of 8 to 500 μs . After reaction the products were rapidly quenched from 800°C to $\sim 400^\circ\text{C}$ within 200 μs , as they mixed with the cold unreacted gases that had passed between the gauze wires of the catalyst. This allows selective production and survival of oxygenates.

A single Pt gauze catalyst layer produces high oxygen conversions and very different selectivities from coated monoliths or multiple gauzes, with parent olefin, formaldehyde and acetaldehyde being the most partially oxidated products. For ethane, propane, *n*-butane and isobutane different reactivities and selectivities were observed: selectivity to olefins strongly decreased, while selectivity to oxygenates increased with

alkyl chain length. At least 40% of reacted butane was converted, mostly to formaldehyde and acetaldehyde.

Steady conversions and selectivities were reached after several hours, with temperatures at $> 800^\circ\text{C}$. The near-adiabatic conditions prevent carbon formation.

Besides being used as a single gauze, the gauze may also be used to preheat gases for partial oxidation by oxide catalysts, such as V_2O_5 . These catalysts produce partially oxidised products with high selectivity and require very high ignition temperatures, so preheating is necessary for high conversions and adiabatic operation. A single platinum gauze, placed in front of the oxide catalyst, could preheat the gases to the required temperature. Rapid quenching would keep the conversion low so alkanes and oxygen would remain for reaction on the catalyst.

The reactor has also been operated at 70 m/s, which suggests that sonic flow could be obtained, with supersonic quenching. This increased speed of reaction might further stabilise useful chemical species.

At present, the reactors are producing ~ 20 kg/day of aldehydes and butylene from butane. A reactor of 0.3 m diameter could produce ~ 1000 metric tons/day at 70 m/s under these conditions. With higher pressures and velocities, and if products are removed and reactants added between catalyst layers, even higher yields and greater selectivities may result.