Solar Energy Conversion of Water to Hydrogen

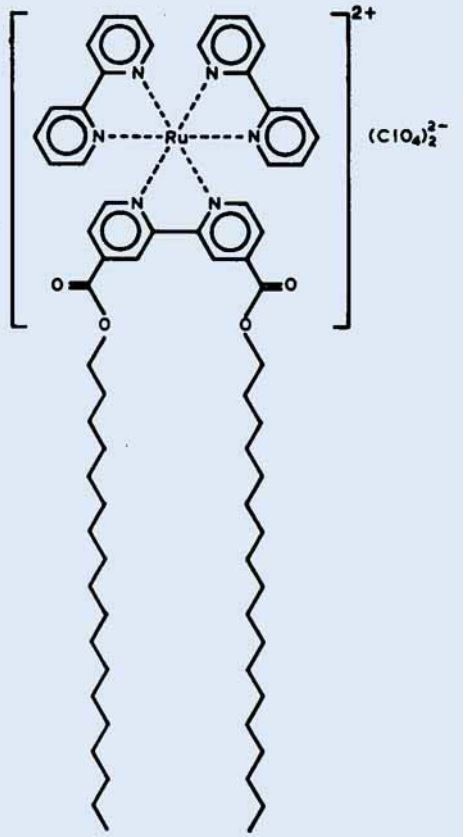
PHOTOCHEMICAL CLEAVAGE WITH A RUTHENIUM COMPLEX

A potentially most important discovery of a means of producing hydrogen from water by photochemical cleavage has been announced by a team led by Professor David G. Whitten of the Department of Chemistry in the University of North Carolina. The reaction, which could have a major impact on future energy requirements, involves a ruthenium complex, tris(2, 2′-bipyridine)ruthenium (II)$^{2+}$.

One of the most efficient processes for converting optical energy into chemical energy has been shown to be photo-induced electron transfer, and it has been shown earlier that essentially all the excitation energy of this complex can be used to transfer an electron to a long-lived reduced species. Unfortunately it has not so far been possible to make use of this reaction as an energy conversion process because the hydrogen and hydroxyl ions rapidly reformed to water.

Professor Whitten and his colleagues have now found (Gerhard Sprintschnik, Hertha Sprintschnik, Pierre Kirsch and David Whitten, *J. Am. Chem. Soc.*, 1976, **98**, (8), 2337–2338) that by reacting this compound with dioctadecyl or dihydrocholesteryl esters to yield long-tailed surfactant complexes insoluble in water, these can effectively promote cleavage. Spread as a monolayer on sheets of glass, in contact with water and irradiated by light, these complexes give rise to a steady stream of molecular hydrogen and oxygen. The presence of the long tails apparently lowers the barrier to the electron transfer process, although it is admitted that a detailed mechanism cannot yet be established.

The efficiency of the reaction is relatively high—of the order of 10 per cent—and further work is being carried out to determine its scope and mechanism, but the results so far obtained indicate that this novel means of solar energy conversion is extremely promising if it can be successfully developed on a large scale.



This insoluble ruthenium complex having the metal atom at the centre of three bipyridyl residues and with long octadecyl tails attached to the ring has the unusual property of separating the reactive components of water to form molecular hydrogen and oxygen