

c1.10

AQUEOUS ORGANIC REACTIONS INDUCED BY HIGH ENERGY
CONDITIONS, A NEW AREA OF RADICAL CHEMISTRY.

Kaoru Harada

University of Tsukuba and Shoin Womens University*

*Sumiregaoka 2-2-1-912, Takarazuka, 665, Japan

Water molecules can be dissociated under high energy conditions into hydrogen and hydroxyl radicals, which are the strongest reducing and oxidizing chemical species, respectively ($\text{H}_2\text{O} \rightarrow \cdot\text{H} + \cdot\text{OH}$ dissociation energy: 117 Kcal/mol). These radicals are readily generated by glow discharge and plasma jet applied against liquid water and also found in the hydrogen-oxygen flame. Therefore, if such high energy conditions are applied to aqueous solution of organic compounds, various kinds of chemical reactions proceed to form bioorganic compounds. The types of chemical reactions induced are: 1) oxidation, 2) hydrogenation, 3) hydroxylation, 4) hydration, 5) dehydrogenation, 6) amination, 7) carboxylation, 8) dimerization, 9) reductive fixation of molecular nitrogen, 10) formation of organic compounds from elemental carbon and 11) various combinations of the above mentioned reactions.

The aqueous reactions induced by these high energy conditions are new and unusual in that they are able to proceed chemical reactions which are unable under the conditions used for conventional organic reactions. Although the main active species, $\cdot\text{OH}$ and $\cdot\text{H}$ radicals, are extremely strong, the reactions are relatively controlled and clean compared with gas phase plasma reactions.

These types of reactions could take place under prebiotic conditions and could be considered as plausible simulation reactions of the primitive hydrosphere irradiated by charged particles such as solar wind when the primitive Earth did not have a magnetic field. Lightning striking on the surface of the hydrosphere could also be a reasonable energy source for this type of reaction.

We have studied various reactions induced by these high energy chemical species. In this presentation, some new experimental results of this type of radical reactions will be presented and discussed in connection with prebiological chemistry.