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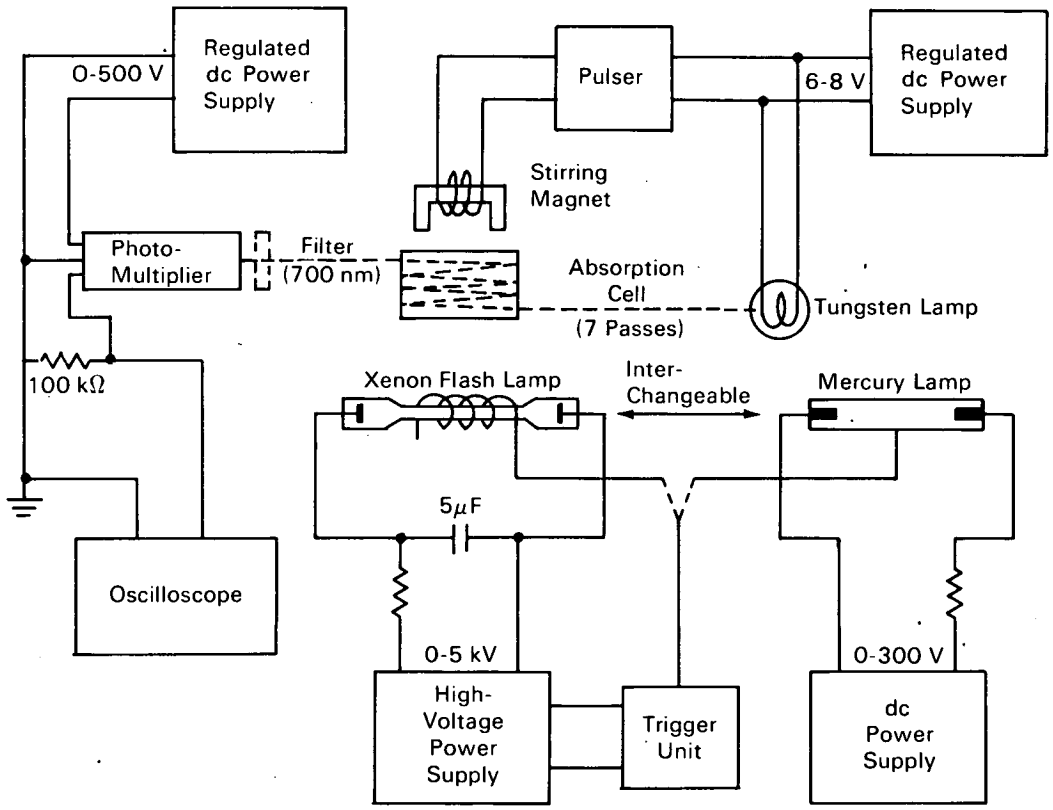
AEC-NASA TECH BRIEF

Compact Apparatus for Photogeneration of Hydrated Electrons



A new flash-photolysis instrument specially designed to generate hydrated electrons and for study of their reactions is described in detail in the reference. With its unique, three-dimensional, multiple-reflection cell and its capacity to produce up to $10^{-7} Me^-_{aq}$ in a single 40-μsec light pulse, this instrument provides adequate sensitivity for determination of e^-_{aq} rate constants and for use in analytical chemistry. With the instrument, less than $10^{-9} Me^-_{aq}$ can be detected.

Hydrated electrons are generated in a H_2-saturated alkaline solution by a flash of ultraviolet light. The well-established reactions producing e^-_{aq} are

$$OH^- + h\nu \rightarrow OH + e^-_{aq} \quad (1)$$

$$OH + H_2 \rightarrow H_2O + H \quad (2)$$

$$H + OH^- \rightarrow e^-_{aq} \quad (3)$$

Note that each light quantum, effective in reaction-1, eventually produces a second e^-_{aq} via reactions 2 and

(continued overleaf)

3; but scavengers such as O_2, when present even in submicromolar concentrations, profoundly affects its formation and decay. For their elimination the solutions are preirradiated with a second ultraviolet mercury lamp. After cleanup, the syringe-handling technique is used to add the scavengers at submicromolar levels. During preirradiation and after the injection of samples, the solution in the cell is mixed by a small, glass-encased, iron rod that is activated by a solenoid receiving repetitive pulses from a pulse-generating circuit.

The apparatus shown consists of a xenon flash lamp, a mercury ultraviolet lamp, a suprasil (R) quartz irradiation cell, a tungsten lamp, an optical system, red filters, a photomultiplier, and an oscilloscope.

The hydrated-electron concentration is followed by monitoring of the light-transmission of the solution at 700 nm near its optical-absorption maximum. At this wavelength its molar extinction coefficient is $1.85 \times 10^4\ M^{-1}\ cm^{-1}$. For increased sensitivity the narrow analyzing light beam from a tungsten lamp is passed through the cell seven times. Next the light passes through a red-filter combination and then into the cathode of a photomultiplier tube. The transient absorption signal is finally displayed on an oscilloscope and recorded.

Reference:

Schmidt, K.; Hart, E. J.: A Compact Apparatus for Photogeneration of Hydrated Electrons. Argonne National Laboratory, Jan. 1968.

Notes:

1. This information may interest researchers studying hydrated electrons.
2. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B70-10036
Source: K. Schmidt, E. Hart
Chemistry Division
(ARG-10487)

Patent status:

Inquiries concerning rights to commercial use of this innovation may be made to:

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