Letters to the Editor

Photolysis of Some Organic Phosphate Compounds

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Several workers have already reported on the photolyses of some organic phosphate compounds to orthophosphate by use of Hg-lamps[1,2] or a combined Zn–Cd–Hg lamp.[3] However, these photolyses have not been commonly applied to the routine analysis of phosphorus in these compounds and can not be effectively applied to a number of organic phosphate compounds having different absorptions in the UV region, because the spectral power distributions of these lamps are discontinuous in the UV region. Further, they require a special irradiation cell equipped with a light source.

We attempted to photolyze two organic phosphate compounds, adenosine 5'-monophosphoric acid (AMP) and flavin mononucleotide (FMN), which are involved in living bodies. We used a water-cooled 200 W D_2 lamp, without the above-mentioned special irradiation cell, which has a continuous power-distribution in the 200–350 nm region, such as is necessary for the photolysis of many organic phosphate compounds (Fig. 1).

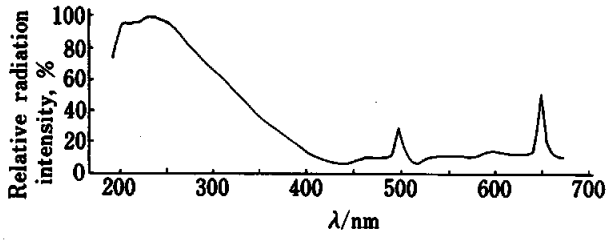

Fig. 1 Spectral power-distribution of D_2 lamp.

Experimental

The photolysis of organic phosphate compounds was carried out using a water-cooled 200 W D_2 lamp (Hamamatsu Photonics model L-1314x). A diagram

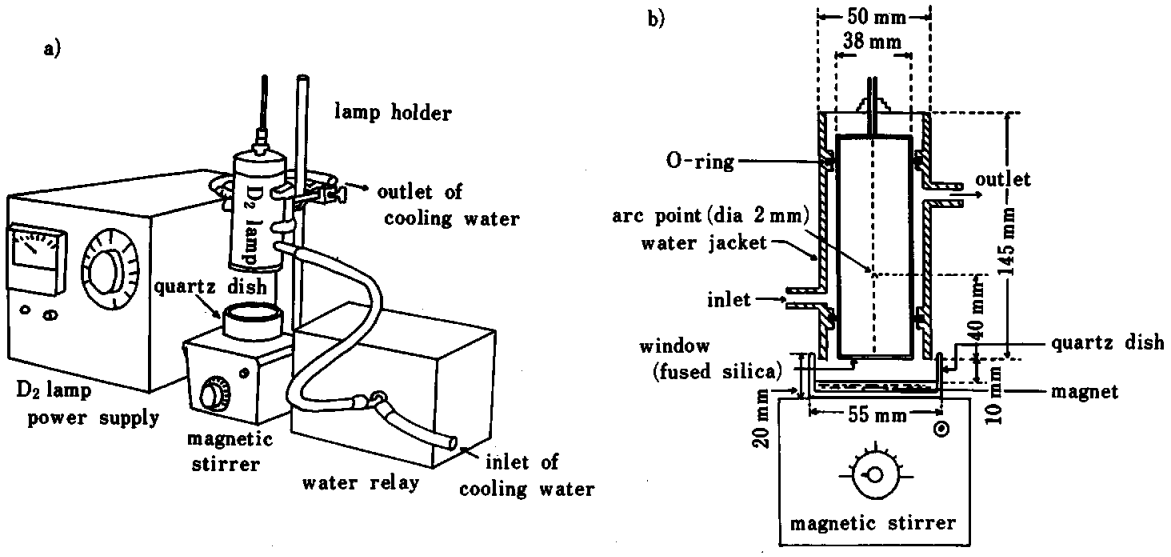

Fig. 2 A diagram of the proposed photolytic system. a) a sketch of the photolytic apparatus; b) details of water-cooled D_2 lamp.

of the photolytic system is shown in Fig. 2. A quartz dish coated on the outside with a aluminum was used as a vessel for the photolytic sample solution in order to enhance irradiation efficiency.

AMP and FMN aqueous solutions (3.23 mmol/l, *i.e.*, P: 100 ppm) were prepared by adenosine 5'-monophosphoric acid and sodium flavin mononucleotide in water.

General procedure of photolysis. Five ml of AMP or FMN aqueous solution (5.46 μmol/l, *i.e.*, P≤0.2 ppm) was transferred to the quartz dish. The solution was irradiated under a constant irradiation matrix of the proposed photolytic system with stirring for a desired time. The irradiated solution was transferred into a 25 ml volumetric flask and the orthophosphate ion converted was determined by the Molybdoheteropoly Blue method.[4]

Results and Discussion

We choose AMP and FMN as samples because these compounds are closely related to living bodies, and especially because the latter compound in an aqueous solution exhibits a fluorescence as well as two maximum absorption in the UV region. The photolysis can be monitored by use of these spectra.

The spectral power-distribution of the D_2 lamp is shown in Fig. 1. The photolysis of many organic phosphate compounds with a D_2 lamp may be more effective than the conventional photolysis[1-3], because these compounds often have maximum absorptions in the 200 - 350 nm region and the D_2 lamp has a strong and continuous spectrum in this region.

Figure 3 shows plots of the photolytic rates of different amounts of AMP and FMN in 5 ml aqueous solution *versus* the irradiation time under the matrix of the present photolysis. It is evident from these results that less than 6.46 μmol/l (0.2 ppm as P) of AMP and FMN can be converted completely into orthophosphate within at most 30 min by the present method.

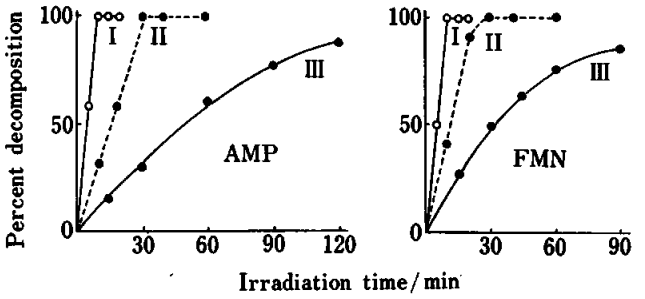

Fig. 3 Photodecompositions of AMP and FMN to orthophosphate by the proposed photolysis with a D_2 lamp. I, 0.1 μgP/5 ml(0.02 ppm); II, 1.0 μgP/5 ml (0.20 ppm); III, 10.0 μgP/5 ml (2.00 ppm).

This photolytic technique requires a sample solution of less volume than the conventional photolysis, without any heating of the sample solution using the special irradiation cell. Therefore, the present method may be widely applied not only to the photolysis of small amounts of other organic phosphate compounds as well as AMP and FMN, but also to the determination of phosphorus in these compounds without any wet-chemical pretreatment.

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