Applications in laser photochemistry

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The development of tunable lasers to produce monochromatic high intensity optical radiation has provided new tools of great power for measuring, controlling and promoting chemical processes. Laser technology can now supply many of the research tools needed for laboratory investigations in these areas, but industrial applications are limited by the availability of reliable, cost effective hardware and processes.

The measurement and control of industrial chemical processes requires the least extension of existing technology and should experience the most rapid development since existing lasers can be used to make non-intrusive, real time measurements of chemical process streams on chemical composition, environmental parameters and flow velocities.

In order to promote chemical reactions, lasers can be used to supply activation energy by exciting high vibrational or electronic states, by selective breaking of bonds to produce new chemical species or free radicals and by changing environmental parameters such as temperature or hydrogen ion concentration.

Examples of laser induced chemistry studied at Los Alamos include the purification of silane for use in production of photovoltaic cells for low cost units for solar energy; conversion of butene from the cis to the trans isomer through the generation of a homogenous catalyst; the synthesis of decaborane; the demonstration of free radical chemistry; the transient change of pH over many decades by laser radiation and the separation of many isotopes throughtout the periodic table.

激光在光化学中的应用

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(洛斯·阿拉莫斯科学实验室)

可调谐激光器的发展已能够获得高强度单色光辐射，这就提供了用来测量、控制和促进化学过程的新的强有力的工具。激光技术现在能够提供在这个领域中进行实验室研究所需要的许多研究工具。但就其工业应用来看受到可靠性、价格-效果适当的器件及化学过程的适用性的限制。

由于现有的激光器可以用来对化学成份的化学流程、环境参量和流速进行无扰动的实时测量，因而工业化学过程的测量和控制只需对现有技术作很少更动而且应有最迅速的发展。

为了促进化学反应，可用激光供给激活能：通过激光激发高振动态或高电子态，通过对化学键选择破坏从而产生新的化学成份或自由基以及通过改变温度或氢离子浓度等环境参量。

在洛斯·阿拉莫斯研究的激光感应化学的例子包括提纯硅烷，它用于生产廉价太阳能光电池；通过产生均匀的催化剂可把丁烯由顺式转换为反式同分异构物；合成癸硼烷；演示自由基化学；用激光辐射瞬时改变酸碱度几十倍以上和分离整个周期表中许多同位素。