# 卢嘉锡论文选

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卢嘉锡论文选

**福建籍科学家论文选集丛书**

卢嘉锡

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福建科学技术出版社出版
(福州得贵巷 27 号)
福建省新华书店发行
福建省地质印刷厂印刷
开本 850×1168 毫米 1/32 17.125 印张 5 插页 405 千字
1992 年 12 月第 1 版
1992 年 12 月第 1 次印刷
印数:1—1200
ISBN 7—5335—0590—5/C.6
定价:17 元

书中如有印装质量问题,可直接向承印厂调换

盧嘉錫

# 序

卢嘉锡同志在物理化学和理论化学特别是结构化学领域从事教学，科研工作逾五十年，取得了累累硕果，为我国结构化学奠基人之一，已成为国内外知名的科学家。这部《卢嘉锡论文选》就是嘉锡同志几十年辛勤耕耘、呕心沥血的结晶，也是我们化学界在结构化学研究方面的宝贵财富。

卢嘉锡同志在科研方面有其独特而又富于创新的学术指导思想。在创办中国科学院福建（原名华东）物质结构研究所的过程中，他提出了在科学工作中要贯彻实验与理论、化学与物理（及其它非化学学科）、结构与性能、静态与动态、基础与应用等五个双结合（而且各以两者的前一个为主）。如今，物构所这个全国结构化学综合研究基地之一，已建立和奠定了具有自己特色的研究方向和研究内容；尤其近十年来，在化学模拟生物固氮、过渡金属原子簇化学、非线性光学晶体材料科学、激光晶体材料科学等方面取得了多项重大成果；在化学固氮和过渡金属原子簇化学的研究中提出了“活性元件组装”设想和“类芳香性”等新颖而富有创见的学术思想，博得了国内外同行们的赞誉。

卢嘉锡同志在科研方面有其敏锐的洞察力。他时刻关注着国际科研发展的最新动态。50年代后期和70年代前期，在化学界出现了两次硼原子簇化学研究的高潮，在这两高潮来临时，嘉锡同志都在不同场合作过这方面的综合学术报告，对这个国际最新研究动态做了详细的介绍和评价，对推动原子簇化学在我国的发展起了重要作用，我和徐光宪同志就是在他的影响下开始进行这方面的研究工作的。1987年，福州大学化学系教授黄建全同志（物构所兼职研究员）根据自己的实验结果肯定了一些$[Mo_3S_4]^{4+}$簇合物在一系列化学反应和结构参数方面的类苯性，嘉锡同志马上抓住了这个新思想并坚持不懈地深入研究下去，确立了类芳香性的概念，取得了很大成就，为国内外学术界所瞩目。

卢嘉锡同志在教学和培养人材方面成绩卓著，可谓“桃李满园”。1945年底他刚回厦大化学系任教时，整个厦大还是满目疮痍，再加上国民党发动内战，使得民不聊生，怨声载道，办学更是举步维艰。在这种非常艰难的条件下，嘉锡同志和全校师生一起，想方设法，克服困难，组织力量护校，把厦门大学维持了下来。全国解放后，我们迎来了教育和科学的春天，嘉锡同志更是全心全意地投入到厦门大学化学系和理学院的建设中去。今天的厦门大学化学系已成为海



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内外闻名、人材济济的厦门大学化学化工学院，这与他当年的辛勤劳动是分不开的。50年代初期，国家为培养物质结构方面的师资人材，原高教部曾两次开设暑期培训班，第一次由我们两位主讲，第二次又增加了吴征铠和徐光宪同志。今天，大部分在物质结构化学方面比较有所作为的科学家都曾受益于这两次培训。嘉锡同志常说："一个老师若培养不出几个比他自己更为出色的学生，他就不是一个好老师。"中国科学院学部委员、厦门大学化学教授、前任校长田昭武，中国科学院学部委员、厦门大学化学教授、化学化工学院院长、前任中国科学院福建物质结构研究所所长张乾二等都是他的得意门生，还有不少人，虽不曾直接受教于他，但在学术上得到他的全心指导和帮助而受益匪浅，物构所研究员、著名非线性光学晶体材料科学家陈创天就是其中之一。

卢嘉锡同志有很强的民族自尊心。他1937年出国留学，1939年在英国伦敦大学获博士学位后转赴美国继续深造；1945年底抗日战争刚结束，他就放弃国外优裕的工作和生活条件，毅然归来。1986年在制定"八六三"计划时，他就提到，搞高技术跟踪是对的，也是必要的，但不能老搞跟踪，要有自己创新的东西，要设法让别人"反跟踪"，唯有这样才能自立于世界科学技

术之林。他经常以我国科技领域及物构所所取得的成绩为例告诉大家，中国人并不笨，我们会迎头赶上来的。

我与嘉锡同志相识于1951年，前后交往已40多年，彼此结下深厚的友谊。也由于我们俩在年龄、身材及教学风格上非常相近，被人戏称为一个“共价键”。1955年我们同时被聘为中国科学院在化学方面最年轻的学部委员，同年又同被原高教部聘为一级教授。在与嘉锡同志的交往中，我发现嘉锡同志非常勤奋、好学，他思想敏锐，富有创新精神；在待人接物方面，他人品很高，为人宽厚，胸怀宽广、坦白，在学术界深得赞誉。

这部《卢嘉锡论文选》的出版，相信会对我国乃至国际结构化学尤其是过渡金属原子簇化学的研究起到很大的促进作用。在此，我以一个老朋友、老同志、老同行的身份，祝愿嘉锡同志健康长寿，在事业上有更大建树！也向为支持嘉锡同志献身事业而作出重大牺牲的嫂夫人逊玉同志致以最良好的祝愿！

唐敖庆

1992. 2. 15

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# 1 Chemical Methods of Concentrating Radioactive Halogens

When organic halides are irradiated with neutrons a considerable amount of the radioactive halogen formed can be separated by extraction with suitable reagents (Szilard and Chalmers, *Nature*, 1934, 134, 462). In the present paper a quantitative study of this phenomenon has been made, a variety of halides and a number of reagents to extract the radioactive product being used.

It has been found that although radio-iodine is separable mainly as the free element, chlorine and bromine are largely extracted as anions. The addition of a little aniline to the halide before irradiation has given a larger yield of extractable radio-bromine. A method based on this reaction for preparing highly active specimens of radio-bromine has been developed, and a concentration factor of 30,000 has been obtained.

SZILARD and CHALMERS (*Nature*, 1934, 134, 462) first showed that by suitable chemical methods a radioactive isotope can be very highly concentrated and separated from nonradioactive isotopes. They irradiated ethyl iodide containing traces of iodine with neutrons and then extracted the iodide with water; the extract was found to contain a large radioactivity associated with only a small

fraction of the total iodide irradiated. Later, Fermi, Amaldi *et al.* (*Proc. Roy. Soc.*, 1935, A, 149, 522) applied similar methods to obtain concentrates of radioactive isotopes of the halogens, manganese, and arsenic. More recently, Paneth and Fay (J., 1936, 384) have used electrical methods of concentration, and Glückauf and Fay (J., 1936, 390) have shown that the halogen atoms expelled by recoil from captive $\gamma$-rays can frequently give rise to substitution products, *e. g.*, dibromobenzene from bromobenzene, etc.

Erbacher and Philipp (Ber., 1936, 69, 893; *Z. physikal. Chem.*, 1936, A, 176, 169) have also studied the separation of radioactive halogens by aqueous extraction of irradiated alkyl halides and by adsorbing the halide ions on charcoal. These workers were primarily interested in obtaining the radio-halogens as free as possible from inactive halogen, and have devised methods which reduce the concentration of halogen in the aqueous solution to unweighable amounts whilst retaining a large amount of activity. They did not, however, compare the radioactivity of these extracts with the total radioactivity generated in the organic halide; hence it is difficult to compare their results with those obtained in this investigation.

The work described below was directed towards a quantitative study of the phenomena of chemical concentration of radio-elements. Special attention has been paid to radiobromine, since this element gives *inter alia* a radioactive isotope with a half-life of 33 hours which makes it particularly valuable as an indicator in kinetic studies.

*Apparatus and Plan of Experiments.*—The source of neutrons contained 200 mg. of radium sulphate mixed with powdered berylli-

um and sealed in a platinum cylinder. This fitted into a recess in a paraffin-wax cylinder around which an annular glass vessel held the liquid to be irradiated. This glass vessel fitted into a cavity in a large block of wax so as to utilise the neutrons which are scattered back by the wax.

The β-ray activity of the specimens was measured in annular glass vessels with very thin inner walls which fitted closely over a Geiger-Müller counter. Several such vessels were prepared of such a size that 25 c. c. of liquid gave a column of more than twice the length of the "window" which admitted β-rays to the counter. To allow for the inevitable variation from vessel to vessel of the thickness of the inner wall, the vessels were calibrated by measurements with a dilute solution of uranyl nitrate.

The impulses generated in the Geiger-Müller counter were passed to a simple one-valve amplifier; this was transformer coupled to a gas-filled relay which operated a telephone call counter. Later, a more elaborate amplifier followed by a thyratron "scale of eight" counter (Wynne-Williams, *Report Prog. Physics*, 1936, 3, 239) was used and the accuracy and speed of the experiments were much improved. This equipment was tested with a series of solutions of known uranium content and its response was found to be accurately proportional to the uranium content up to a speed of 600 impulses/min. At 1000 impulses/min. the correction for coincident counts was small.

Some of the earlier experiments were made with counters filled with air at 80 mm. pressure; later the mixture of 90 mm. of argon and 10 mm. of ethyl alcohol vapour recommended by Trost

(*Z. Physik*, 1937, 105, 399) was used and found to be much more satisfactory. Although our counters were constructed with ebonite end-pieces, there was rarely a failure when constructing new counters and many of them have had a useful life of more than six months.

The general method adopted to study the extraction of the radioactive product was to irradiate an organic halide and then divide it into two or more portions. One was retained as standard, and the others then shaken with suitable reagents and separated. The activities of the samples of organic halides were then measured, and the loss on extraction determined. With this procedure no correction is needed for absorption of $\beta$-rays in the medium. In a few experiments it was necessary to measure an activity in an aqueous solution and compare it with an activity in an organic halide. The correction for the difference in self-absorption was then determined by appropriate subsidiary experiments.

In most cases the period of counting was chosen so that at least 1500 impulses were recorded; the error due to chance fluctuations was then less than 3%. The activities quoted in the tables below have been corrected for radioactive decay, for self-absorption (where necessary), and for variations in thickness of vessel walls.

A permanent standard of β-ray activity was constructed by mounting a few mg. of $U_3O_8$ on a strip of gummed paper inside a glass tube which fitted over the counter. This served as a convenient monitor for controlling the performance of the counter and indicated any change in its sensitivity. Measurements of this "uranium standard" were interpolated between other measurements and the re-



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