{{Infobox element

|number=81

|symbol=Tl

|name=鉈

|enname=Thallium

|left=[[汞]]

|right=[[鉛]]

|above=[[銦]]

|below=[[Uut]]

|series=貧金屬

|group=13

|period=6

|block=p

|image name= Thallium pieces in ampoule.jpg

|appearance=銀白色

|atomic mass= 204.38

|atomic mass 2=1

|electron configuration= &#91;[[氙]]&#93; 4f<sup>14</sup> 5d<sup>10</sup> 6s<sup>2</sup> 6p<sup>1</sup>

|electrons per shell= 2, 8, 18, 32, 18, 3

|phase= 固體

|density gpcm3nrt= 11.85

|density gpcm3mp= 11.22

|melting point K=577

|melting point C=304

|melting point F=579

|boiling point K=1746

|boiling point C=1473

|boiling point F=2683

|heat fusion= 4.14

|heat vaporization= 165

|heat capacity= 26.32

|vapor pressure 1= 882

|vapor pressure 10= 977

|vapor pressure 100= 1097

|vapor pressure 1 k= 1252

|vapor pressure 10 k= 1461

|vapor pressure 100 k= 1758

|vapor pressure comment=

|crystal structure= 六方密堆積

| oxidation states = 3, 2, '''1'''<br />（微[[鹼性]]氧化物）

|electronegativity= 1.62

|number of ionization energies=3

|1st ionization energy= 589.4

|2nd ionization energy= 1971

|3rd ionization energy= 2878

|atomic radius= 170

|covalent radius= 145±7

|Van der Waals radius= 196

|magnetic ordering= [[抗磁性]]<ref>[http://www-d0.fnal.gov/hardware/cal/lvps\_info/engineering/elementmagn.pdf Magnetic susceptibility of the elements and inorganic compounds], in Handbook of Chemistry and Physics 81st edition, CRC press. </ref>

|electrical resistivity at 20= 0.18 µ

|thermal conductivity= 46.1

|thermal expansion at 25= 29.9

|speed of sound rod at 20= 818

|Young's modulus= 8

|Shear modulus= 2.8

|Bulk modulus= 43

|Poisson ratio= 0.45

|Mohs hardness= 1.2

|Brinell hardness= 26.4

|CAS number= 7440-28-0

|isotopes=

{{Elementbox\_isotopes\_decay | mn=203 | sym=Tl | na=29.524% | hl=- | dm=([[α衰變|α]]) | de=0.9108 | pn=199 | ps=Au }}

{{Elementbox\_isotopes\_decay2 | mn=204 | sym=Tl

| na=[[放射性同位素|人造]] | hl=3.78年

| dm1=[[β衰變|β<sup>−</sup>]] | de1=0.764 | pn1=204 | ps1=Pb

| dm2=[[電子捕獲|ε]] | de2=0.347 | pn2=204 | ps2=Hg}}

{{Elementbox\_isotopes\_decay | mn=205 | sym=Tl | na=70.476% | hl=- | dm=([[α衰變|α]]) | de=0.1567 | pn=201 | ps=Au }}

|isotopes comment=帶括號的衰變模式為理論預測，尚未有實驗觀測證實

|discovered by=[[威廉·克鲁克斯]]

|discovery date=1861

|first isolation by=[[克洛德-奧古斯特·拉米]]

|first isolation date=1862

}}

'''鉈'''（'''Thallium'''）是一種化學元素，符號為'''Tl'''，原子序為81。鉈是一種質軟的灰色[[貧金屬]]，在自然界中並不以單質存在。鉈金屬外表和[[錫]]相似，但會在空氣中失去光澤。兩位化學家[[威廉·克魯克斯]]和[[克洛德-奧古斯特·拉米]]在1861年獨立發現了這一元素。他們都是在[[硫酸]]反應殘留物中發現了鉈，並運用了當時新發明的[[火焰光譜法]]對其進行了鑑定，觀測到鉈會產生明顯的綠色譜線。其名稱「Thallium」由克魯克斯提出，來自[[希臘文]]中的「{{lang|el|θαλλός}}」（thallos），即「綠芽」之意。翌年，拉米用電解法成功分離出鉈金屬。

鉈在氧化後，一般擁有+3或+1氧化態，形成離子鹽。其中+3態與同樣屬於[[硼族元素|硼族]]的[[硼]]、[[鋁]]、[[鎵]]和[[銦]]相似；但是鉈的+1態則比其他同族元素顯著得多，而且和[[鹼金屬]]的+1態相近。鉈(I)離子在自然界中大部份出現在含[[鉀]]礦石中。生物細胞的離子泵處理鉈(I)離子的方式也和鉀(I)類似。

在商業開採方面，鉈是硫化重金屬礦提煉過程的副產品之一。總產量的60至70%應用在電子工業，其餘則用於製藥工業和玻璃產業。<ref name="sl2001"/>鉈還被用在[[紅外線]]探測器中。[[放射性同位素]]鉈-201（以水溶氯化鉈的形態），在[[核醫學]]掃描中可用作[[示蹤劑]]，例如用於[[心臟負荷測試]]。

水溶鉈鹽大部份幾乎無味，且都是[[毒性|劇毒物]]，曾被用作[[殺鼠劑]]和[[殺蟲劑]]以及謀殺工具。這類化合物的使用已經被多國禁止或限制。鉈中毒會造成脫髮。<ref>{{cite book|title = The Boron Elements: Boron, Aluminum, Gallium, Indium, Thallium| page = 14| first =Heather|last = Hasan|year = 2009| isbn = 978-1-4358-5333-1|publisher = Rosen Publishing Group}}</ref>

==性質==

鉈金屬非常軟，可[[延展性]]很高，在室溫下可以用刀切割。它具有金屬光澤，但在接觸空氣之後，會變為藍灰色，與[[鉛]]相似。長期置於空氣中的鉈會形成厚厚的氧化表層。要保存它的光澤，可以將其浸泡在油裡。當接觸水後，會形成氫氧化鉈。硫酸和[[硝酸]]能快速溶解鉈，分別形成[[硫酸亞鉈]]和[[硝酸亞鉈]]，而[[氫氯酸]]則會使鉈表面形成一層不可溶的[[氯化鉈]]。<ref name="HollemanAF">{{cite book|publisher = Walter de Gruyter|year = 1985|edition = 91–100|pages = 892–893|isbn = 3-11-007511-3|title = Lehrbuch der Anorganischen Chemie|first = Arnold F.|last = Holleman|coauthors = Wiberg, Egon; Wiberg, Nils|chapter =Thallium|language = German}}</ref>其[[標準電極電勢]]為−0.34，比[[鐵]]的−0.44稍低。

===同位素===

{{main|鉈的同位素}}

鉈共有25種[[同位素]]，[[原子量]]介乎184和210之間。穩定同位素有<sup>203</sup>Tl和<sup>205</sup>Tl，而<sup>204</sup>Tl則是最穩定的[[放射性同位素]]，[[半衰期]]有3.78年。<ref name="Audi">{{cite journal| last = Audi|first = Georges|title = The NUBASE Evaluation of Nuclear and Decay Properties|journal = Nuclear Physics A|volume = 729| issue = 1|pages = 3–128| publisher = Atomic Mass Data Center|year = 2003| doi=10.1016/j.nuclphysa.2003.11.001| bibcode=2003NuPhA.729....3A| last2 = Bersillon| first2 = O.| last3 = Blachot| first3 = J.| last4 = Wapstra| first4 = A.H.}}</ref>

<sup>202</sup>Tl（半衰期12.23天）可以在[[迴旋加速器]]中合成，<ref>{{cite web|url = http://web.archive.org/web/20090413195931/http://hss.energy.gov/healthsafety/ohre//roadmap/histories/0472/0472d.html|title = Thallium Research|publisher = United States Department of Energy|accessdate = 2010-05-13}}</ref>而<sup>204</sup>Tl可以在[[核反應爐]]中對鉈的穩定同位素進行[[中子活化]]製成。<ref name="Audi"/><ref name="Audi"/><ref>{{cite web|url =http://www-pub.iaea.org/MTCD/publications/PDF/te\_1340\_web.pdf|title = Manual for reactor produced radioisotopes|publisher = [[International Atomic Energy Agency]]|year = 2003|accessdate = 2010-05-13}}</ref>

<sup>201</sup>Tl（半衰期73小時）會以[[電子捕獲]]的方式進行衰變，並釋放Hg [[X射線]]（約70至80&nbsp;[[電子伏特|keV]]）以及總豐度為10%、能量分別為135和167&nbsp;keV的[[光子]]。<ref name="Audi"/>它既能提供良好的示蹤效果，又不會使病人承受過大的輻射劑量，所以是核醫學成像的理想示蹤劑。它是鉈元素核子[[心臟負荷測試]]中最常用的同位素。<ref>{{cite book|url = http://books.google.com/?id=CqQgnHrDxrUC&pg=PA173|chapter = Detection, Evaluation, and Risk Stratification of Coronary Artery Disease by Thallium-201 Myocardial Perfusion Scintigraphy 155|first1 = Jamshid|last1 = Maddahi|first2 = Daniel|last2 =Berman|title = Cardiac SPECT imaging|edition = 2|publisher = Lippincott Williams & Wilkins|year = 2001|isbn = 978-0-7817-2007-6|pages = 155–178}}</ref>

<sup>208</sup>Tl（半衰期3.05分鐘）是[[釷]][[衰變鏈]]的自然產物之一。它所釋放的2615&nbsp;keV[[伽馬射線]]是自然[[背景輻射]]中的一大主要高能特徵。

===化學性質===

{{Category see also|鉈化合物}}

鉈的兩個主要[[氧化態]]為+1和+3。當處於+1態時，鉈化合物和[[鉀]]或[[銀]]的化合物十分相近，因此在元素剛被發現後不久，一些[[歐洲]]化學家（[[英國]]除外）曾把它當做[[鹼金屬]]。<ref>{{cite journal |last1=Crookes |first1=William |year=1864 |title=On Thallium |journal=The Journal of the Chemical Society, London |volume=XVII |issue= |pages=112–152 |publisher=Harrison & Sons |url=http://books.google.com/books?id=H58wAAAAYAAJ |accessdate=January 13, 2012 |doi=10.1039/js8641700112 }}</ref>{{rp|126}}

氧化態為+3的化合物與相對應的鋁(III)化合物相似。它們具有較高的氧化性，如Tl<sup>3+</sup> + 3 e<sup>–</sup> → Tl(''s'')反應的還原電勢為+0.72&nbsp;V。氧化鉈(III)是一種黑色固體，在800&nbsp;°C以上溫度會分解，形成氧化鉈(I)和[[氧氣]]。<ref name="HollemanAF"/>

==歷史==

1861年，[[威廉·克魯克斯]]和克洛德-奧古斯特·拉米（Claude-Auguste Lamy）利用火焰光譜法，分別獨自發現了鉈元素。<ref>\* （1861年3月30日）Crookes, William "On the existence of a new element, probably of the sulphur group," ''Chemical News'', vol. 3, [http://books.google.com/books?id=6QcAAAAAMAAJ&pg=PA193 pp. 193–194]; reprinted in: {{cite journal|url=http://books.google.com/books?id=OhyQnaPXF5QC&pg=RA1-PA301|date=April 1861|doi=<!-- 10.1080/14786446108643058 broken -->|title=XLVI. On the existence of a new element, probably of the sulphur group|volume =21|issue =140|pages =301–305|journal=Philosophical Magazine}};

\* （1861年5月18日）Crookes, William "Further remarks on the supposed new metalloid," ''Chemical News'', vol. 3, [http://books.google.com/books?id=6QcAAAAAMAAJ&pg=PA303 p. 303].

\* （1862年6月19日）Crookes, William "Preliminary researches on thallium," ''Proceedings of the Royal Society of London'', vol. 12, pages 150–159.

\* （1862年5月16日）Lamy, A. "De l'existencè d'un nouveau métal, le thallium," ''Comptes Rendus'', vol. 54, [http://gallica2.bnf.fr/ark:/12148/bpt6k30115.image.r=Comptes+Rendus+Hebdomadaires.f1254.langFR pages 1255–1262].</ref>由於在火焰中發出綠光，所以克魯克斯提議把它命名為「Thallium」，源自[[希臘文]]中的「{{lang|el|θαλλός}}」（thallos），即「綠芽」之意。<ref>{{cite journal| doi = 10.1021/ed009p2078| title = The discovery of the elements. XIII. Supplementary note on the discovery of thallium| year = 1932| last1 = Weeks| first1 = Mary Elvira|authorlink1=Mary Elvira Weeks| journal = Journal of Chemical Education| volume = 9| issue = 12| page = 2078|bibcode = 1932JChEd...9.2078W }}</ref><ref>Liddell, Henry George and Scott, Robert (eds.) "[http://perseus.mpiwg-berlin.mpg.de/cgi-bin/resolveform?lookup=qallos&type=begin&lang=greek&searchText=&options=Sort+Results+Alphabetically&.submit=Submit&formentry=1&lang=greek θαλλος]", in ''[[A Greek–English Lexicon]]'', Oxford University Press.</ref>

在[[羅伯特·威廉·本生]]和[[古斯塔夫·基爾霍夫]]發表有關改進火焰光譜法的論文，<ref>{{cite journal|title = Chemische Analyse durch Spectralbeobachtungen|pages = 337–381|author = G. Kirchhoff, R. Bunsen|doi = 10.1002/andp.18611890702|journal = [[Annalen der Physik und Chemie]]|volume = 189|issue = 7|year = 1861|bibcode=1861AnP...189..337K}}</ref>以及在1859至1860年發現[[銫]]和[[銣]]元素之後，科學家開始廣泛使用火焰光譜法來鑑定礦物和化學物的成份。克魯克斯用這種新方法判斷[[硒]]化合物中是否含有[[碲]]，樣本由[[奧古斯特·威廉·馮·霍夫曼|奧古斯特·霍夫曼]]數年前交給克魯克斯，是德國[[哈茨山]]上的一座硫酸工廠進行[[鉛室法]]過程後的產物。<ref>{{cite journal|title = Preliminary Researches on Thallium|first = William|last = Crookes|journal = Proceedings of the Royal Society of London,|volume = 12|issue = 0|year = 1862–1863|pages = 150–159|jstor = 112218|doi = 10.1098/rspl.1862.0030}}</ref><ref>{{cite journal|title = On Thallium|first = William|last = Crookes|journal =Philosophical Transactions of the Royal Society of London,|volume = 153|issue = 0|year = 1863|pages =173–192|jstor = 108794|doi = 10.1098/rstl.1863.0009}}</ref>到了1862年，克魯克斯能夠分離出小部份的新元素，並且對它的一些化合物進行化學分析。<ref name="DeKosky">{{cite journal|title = Spectroscopy and the Elements in the Late Nineteenth Century: The Work of Sir William Crookes|first = Robert K.|last = DeKosky|journal = The British Journal for the History of Science|volume = 6|issue = 4|year = 1973|pages = 400–423|jstor = 4025503|doi = 10.1017/S0007087400012553}}</ref>拉米所用的光譜儀與克魯克斯的相似。以[[黃鐵礦]]作為原料的硫酸生產過程會產生含硒物質，拉米對這一物質進行了光譜分析，同樣觀察到了綠色譜線，因此推斷當中含有新元素。他友人弗雷德·庫爾曼（Fréd Kuhlmann）的硫酸工廠能夠提供大量的副產品，這為拉米的研究帶來了化學樣本上的幫助。<ref>{{cite journal|title = De l'existencè d'un nouveau métal, le thallium|journal = Comptes Rendus|year = 1862|first = Claude-Auguste|last = Lamy|volume = 54 |pages = 1255–1262|url = http://gallica2.bnf.fr/ark:/12148/bpt6k30115.image.r=Comptes+Rendus+Hebdomadaires.f1254.langFR}}</ref>他判斷了多種鉈化合物的性質，並通過電解法從鉈鹽產生了鉈金屬，再經熔鑄後製成了一小塊鉈金屬。

拉米在1862年倫敦[[國際博覽會]]上「為發現新的、充裕的鉈來源」而獲得一枚獎章。克魯克斯在抗議之後，也「為發現新元素鉈」而獲得獎章。兩人之間有關發現新元素的榮譽之爭議持續到1862至1863年。爭議在1863年6月克魯克斯獲選為英國[[皇家學會]]院士之後逐漸消退。<ref name="James">{{cite journal|title =Of 'Medals and Muddles' the Context of the Discovery of Thallium: William Crookes's Early|first = Frank A. J. L.|last = James|journal =Notes and Records of the Royal Society of London|volume = 39|issue = 1|year = 1984|pages = 65–90|jstor = 531576|doi =10.1098/rsnr.1984.0005}}</ref><ref name="Murder">{{cite book|title = The Elements of Murder: A History of Poison|chapter = Thallium|first = John|last =Emsley|publisher = Oxford University Press|year = 2006|isbn = 978-0-19-280600-0|url = http://books.google.com/?id=BACSR7TXWhoC|pages = 326–327}}</ref><!-- 鉈曾被用作殺鼠劑，減輕肺結核病人出汗以及一般脫毛之用。Thallium Toxicity and the Role of Prussian Blue in Therapy 10.1016/S1383-5742(97)00022-7 10.1007/BF01684859 http://quod.lib.umich.edu/cgi/t/text/text-idx?c=nal;idno=17038117.0238.001-->

鉈一開始的最大用途是[[殺鼠劑]]。在多次意外之後，美國於1972年2月經第11643號[[行政命令 (美國)|行政命令]]禁止使用鉈殺鼠劑。其他國家也接連實施禁令。<ref name="USGS1972">{{cite book | title = Minerals yearbook metals, minerals, and fuels | year = 1972 | chapter = Thallium | page = 1358 | publisher = United States Geological Survey | url = http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?type=goto&id=EcoNatRes.MinYB1972v1&page=1358&isize=XL| volume = 1 | author = Staff of the Nonferrous Metals Division }}</ref>

==存量及生產==

鉈在地球地殼中并不屬於稀有的物質，含量約為0.7&nbsp;mg/kg，<ref name="USGS-CS2010">{{cite web|first = David E.|last = Guberman|title = Mineral Commodity Summaries 2010: Thallium|url = http://minerals.usgs.gov/minerals/pubs/commodity/thallium/mcs-2010-thall.pdf| accessdate = 2010-05-13|publisher = United States Geological Survey}}</ref>主要存在於[[黏土]]、[[土壤]]和[[花崗岩]]中的[[鉀]]基[[礦物]]內。然而在商業上從這些礦物開採鉈卻並不容易。[[銅]]、[[鉛]]、[[錫]]等重金屬硫化礦中含有微量的鉈元素，這才是其最大的實際來源。<ref>{{cite doi|10.1007/BF01684859}}</ref><ref name="Vira">{{cite journal|doi = 10.1016/j.envint.2004.09.003|title = Thallium: a review of public health and environmental concerns|year = 2005|last1 = Peter|first1 = A|last2 = Viraraghavan|first2 = T|journal = Environment International|volume = 31|pages = 493–501|pmid = 15788190|issue = 4}}</ref>

[[File:Hutchinsonite-131710.jpg|thumb|left|[[硫砷鉈鉛礦]]晶體（TlPbAs<sub>5</sub>S<sub>9</sub>）]]

含有鉈的礦物包括[[硒鉈銀銅礦]]（TlCu<sub>7</sub>Se<sub>4</sub>）、[[硫砷鉈鉛礦]]（TlPbAs<sub>5</sub>S<sub>9</sub>，亦稱紅鉈鉛礦）以及[[紅鉈礦]]（TlAsS<sub>2</sub>）等。<ref>{{cite journal|doi = 10.1016/0016-7037(52)90003-3|title = The geochemistry of thallium|year = 1952|last1 = Shaw|first1 = D|journal = Geochimica et Cosmochimica Acta|volume = 2|issue = 2|pages = 118–154 |bibcode = 1952GeCoA...2..118S }}</ref>[[黃鐵礦]]中也含有微量的鉈，鉈是黃鐵礦加工生產[[硫酸]]過程中的一種副產品。<ref name="sl2001">{{cite web|title=Chemical fact sheet&nbsp;— Thallium|publisher=''Spectrum Laboratories'' |date=April 2001 |url=http://www.speclab.com/elements/thallium.htm|accessdate=2008-02-02}}</ref><ref name="Downs">{{cite book|title = Chemistry of aluminium, gallium, indium, and thallium|first =Anthony John|last = Downs|publisher = Springer|year = 1993|isbn = 978-0-7514-0103-5|pages = 90 and 106|url = http://books.google.com/?id=v-04Kn758yIC}}</ref>

鉈也可以從鉛和錫礦的[[冶煉]]過程中取得。[[海床]]上所發現的[[錳結核]]含有鉈，但如此的開採成本高昂，不切實際。開採過程還可能對生態環境造成破壞。<ref>{{cite journal|doi = 10.1016/j.marchem.2003.09.006|pages = 125–139|title = The mass balance of dissolved thallium in the oceans|year = 2004|issue = 3–4|last1 = Rehkamper|first1 = M|journal = Marine Chemistry|volume = 85|last2 = Nielsen|first2 = Sune G.}}</ref>另外，以[[銻]]、[[砷]]、銅、鉛或[[銀]]為主要成份的一些礦物可以含有16%至60%的鉈，但這類礦物極為罕見，所以並未成為商業開採的主要來源。<ref name="USGS-CS2010"/>位於[[馬其頓共和國|馬其頓]]南部的阿爾沙爾礦場（{{lang-mk|Алшар}}）是歷史上唯一一處開採鉈的礦場。礦藏是幾種稀有鉈礦物的來源，如紅鉈礦，估計總的鉈含量仍有500噸。<ref>{{cite journal|doi = 10.1016/0168-9002(88)90170-2|title = The Allchar Tl–As–Sb deposit, Yugoslavia and its specific metallogenic features|year = 1988|last1 = Jankovic|first1 = S.|journal = Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment|volume = 271|issue = 2|page = 286|bibcode = 1988NIMPA.271..286J }}</ref><!-- The "Alshar" epithermal Au-As-Sb-Tl deposit, located in southern Macedonia, is the only larger mining area 10.1134/S1075701506030020 http://www.jstor.org/pss/2843882 -->

鉈是銅、錫和鉛冶煉過程的副產品，<ref name="USGS-CS2010"/>可以從煙氣或[[熔渣]]中萃取出來。<ref name="USGS-CS2010"/>這些物質都含有許多鉈以外的礦物雜質，所以首先要進行純化。原料經鹼或硫酸浸洗後，可洗出鉈元素，經沉澱移除更多的雜質。最後產生的硫酸鉈可以經[[電解]]把鉈金屬堆積在[[鉑]]片或[[不鏽鋼]]片上。<ref name="Downs"/>[[美國地質調查局]]估計，鉈的全球總年產量為10噸左右。<ref name="USGS-CS2010"/>產量在1995年至2009年間從15噸下降到10噸，降幅為33%。如果鉈有更大的實際應用，例如仍在實驗階段的含鉈[[高溫超導體]]，根據目前鉈礦藏的存量，產量是能夠重新提高的。<ref name="USGS-CS2010">{{cite web|first = Gerald R.|last = Smith| title = Mineral commodity summaries 1996: Thallium|url = http://minerals.usgs.gov/minerals/pubs/commodity/thallium/thallmcs96.pdf| accessdate = 2010-05-13|publisher = United States Geological Survey}}</ref>

==應用==

===被淘汰的用途===

[[硫酸亞鉈]]無臭無味，曾被廣泛用作[[殺鼠劑]]和[[殺蟲劑]]。自1972年起，美國已禁止硫酸亞鉈的使用，<ref name="USGS1972"/>其他國家也接著陸續實施禁令。<ref name="sl2001"/>人們曾使用鉈鹽來治療[[癬]]等皮膚感染病，以及減輕[[肺結核]]病人夜間盜汗的情況。不過這一用途頗為有限，因為鉈鹽的[[治療指數]]區間較窄，更先進的相應藥物也很快將其淘汰了。<ref name=CRC/><ref>{{cite journal|doi = 10.1111/j.1365-2133.1930.tb09395.x|pages =59–69|title = The Treatment of Ringworm of The Scalp with Thallium Acetate|year = 1930|issue = 2|last1 = Percival|first1 = G. H.|journal = British Journal of Dermatology|volume = 42}}</ref><ref>{{cite journal|doi = 10.1016/S0378-4274(98)00126-X| pages =1–13|title = Thallium toxicity|year = 1998|last1 = Galvanarzate|first1 = S|journal = [[Toxicology Letters]]|volume = 99|pmid = 9801025|last2 = Santamarı́a|first2 = A|issue = 1}}</ref>

===光學===

[[溴化鉈]]和[[碘化鉈]][[晶體]]硬度較高，而且能夠透射波長極長的光線，所以是良好的紅外線光學材料，商品名為KRS-5和KRS-6。<ref>{{cite journal|pages = 338–346|doi = 10.1364/JOSA.46.000956|title = Refraction and Dispersion of Thallium Bromide Iodide|year = 1956|last1 = Rodney|issue = 11|first1 = William S.|last2 = Malitson|first2 = Irving H.|journal = [[Journal of the Optical Society of America]]|volume = 46}}</ref>[[氧化亞鉈]]可用來製造高[[折射率]]玻璃，而與[[硫]]或[[硒]]和[[砷]]結合後，可以製成高密度、低熔點（125至150&nbsp;°C）玻璃。這種玻璃在室溫下特性和普通玻璃相似，耐用、不溶於水，且具有特殊的折射率。<ref>{{cite book|url = http://books.google.com/?id=jOOSKQHEJdwC&pg=PA52| publisher =[[CRC Press]]|title = Glasses for infrared optics|isbn = 978-0-8493-3785-7|year = 1996|first = Valentina F. |last = Kokorina}}</ref>

===電子===

[[File:Thallium rod corroded.jpg|thumb|right|受侵蝕的鉈金屬棒]]

[[硫化亞鉈]]的[[電導率]]會隨[[紅外線]]的照射而變化，所以能應用於[[光敏電阻]]。<ref name=CRC>{{cite book| author = Hammond, C. R. |title = The Elements, in Handbook of Chemistry and Physics 81st edition| publisher =CRC press| isbn = 0-8493-0485-7}}</ref>硒化鉈被用於[[輻射熱測量計]]中，以探測紅外線。<ref>{{cite journal| bibcode = 1977ApOpt..16.2942N| title = Thallium selenide infrared detector| author = Nayer, P. S, Hamilton, O.| journal = Appl. Opt.| volume = 16| issue = 11| page =2942|year =1977| doi = 10.1364/AO.16.002942}}</ref>在硒半導體中摻入鉈，可以提高其效能，所以一些硒[[整流器]]中含有這種含鉈半導體。<ref name=CRC/>另一項鉈的應用是在[[伽馬射線]]探測器中的[[碘化鈉]]裡作摻雜物。碘化鈉晶體內摻入少量鉈，可以增強它產生電離閃爍的效果。<ref>{{cite journal|pages =796–810|doi =10.1103/PhysRev.75.796|title =The Detection of Gamma-Rays with Thallium-Activated Sodium Iodide Crystals|year =1949|issue =5|last1 =Hofstadter|first1 =Robert|journal =Physical Review|volume =75|bibcode = 1949PhRv...75..796H }}</ref>[[氧分析儀]]中的一些電極也含有鉈元素。<ref name="sl2001"/>

===高溫超導===

科學家正在進行有關鉈[[高溫超導體]]方面的研究，潛在應用包括[[磁共振成像]]及[[發電]]和電力傳輸等。這些研究在1988年首個[[鉈鋇鈣銅氧]]超導體被發現之後開始。<ref>{{cite journal|journal = Nature|volume = 332|issue = 6160|pages = 138–139|year = 1988|doi = 10.1038/332138a0|title = Bulk superconductivity at 120 K in the Tl–Ca/Ba–Cu–O system|first = Z. Z.|last =Sheng|coauthors = Hermann A. M.|bibcode=1988Natur.332..138S}}</ref>銅酸鉈超導體的臨界溫度超過120&nbsp;K。一些摻汞的銅酸鉈超導體在常壓下的臨界溫度甚至超過130&nbsp;K，幾乎達到已知臨界溫度最高的銅酸汞超導體。<ref>{{cite journal|title=Stabilization of the Tl<sub>2</sub>Ba<sub>2</sub>Ca<sub>2</sub>Cu<sub>3</sub>O<sub>10</sub> superconductor by Hg doping|author=Jia, Y. X.; Lee, C. S.; Zettl, A.|journal=Physica C|volume =234|issue= 1–2|pages=24–28|bibcode=1994PhyC..234...24J|doi=10.1016/0921-4534(94)90049-3|year=1994}}</ref>

===醫學===

在[[核醫學]]廣泛使用[[鍀-99m]]之前，半衰期為73小時的[[鉈-201]]曾經是核心動描記所使用的主要[[放射性同位素]]。今天，鉈-201也被用於針對[[冠心病]]危險分層的負荷測試當中。<ref>{{cite book |title = Essential cardiology: principles and practice|chapter = Nuclear imaging in cardiovascular medicine|first1 = Diwakar|last1 = Jain|first2 = Barry L.|last2 = Zaret|editor = Clive Rosendorff|pages = 221–222| isbn = 978-1-58829-370-1|publisher = Humana Press|url = http://books.google.com/?id=cY182J9q5NoC&pg=PA222|year = 2005|edition = 2}}</ref><!--<ref>[http://www.wramc.amedd.army.mil/departments/nuclear/PatientInfo/Thallium.htm Thallium Test] from [[Walter Reed Army Medical Center]]</ref><ref>[http://www.americanheart.org/presenter.jhtml?identifier=4743 Thallium Stress Test] from the [[American Heart Association]]</ref>-->這一同位素的產生器與用來生成鍀-99m的類似。<ref>{{cite journal|title = An integrally shielded transportable generator system for thallium-201 production|journal = International Journal of Applied Radiation Isotopes|year = 1982|volume = 33|issue = 12|pages = 1439–1443|last = Lagunas-Solar|first = M. C.|coauthors = Little, F. E.; Goodart, C. D.|url = http://www.medscape.com/medline/abstract/7169272 Abstract|doi = 10.1016/0020-708X(82)90183-1|pmid = 7169272}}</ref>產生器中的[[鉛-201]]（半衰期9.33小時）會經[[電子捕獲]]衰變成鉈-201。鉛-201則是在[[迴旋加速器]]中通過(p,3n)或(d,4n)反應分別對鉈進行[[質子]]或[[氘]]核撞擊而產生的。<ref>[http://www.med.harvard.edu/JPNM/physics/isotopes/Tl/Tl201/prod.html Thallium-201 production] from [[Harvard Medical School]]'s Joint Program in Nuclear Medicine</ref><ref>{{cite journal|title =Thallium-201 for medical use| url =http://jnm.snmjournals.org/cgi/content/abstract/16/2/151|pmid =1110421|journal =The Journal of Nuclear Medicine|volume =16|issue =2|pages =151–5|year =1975 | last1 = Lebowitz | first = E.| last2 = Greene | first2 = M. W.| last3 = Fairchild | first3 = R.| last4 = Bradley-Moore | first4 = P. R.| last5 = Atkins | first5 = H. L.| last6 = Ansari | first6 =A. N.| last7 = Richards | first7 = P.| last8 = Belgrave | first8 = E.}}</ref>

====鉈負荷測試====

鉈負荷測試是[[閃爍掃描法]]的一種，它通過測量鉈的含量來推算組織血液供應量。活心肌細胞擁有正常的[[鈉鉀泵|鈉鉀離子交換泵]]。Tl<sup>+</sup>離子會與K<sup>+</sup>泵結合，進入細胞內。<ref name=GJTaylor>{{cite book |url=http://books.google.com/?id=u\_A5BSqsb20C&pg=PA100|page=100|title=Primary care cardiology |author=Taylor, George J. |publisher=Wiley-Blackwell |year=2004 |isbn= 1-4051-0386-8}}</ref>運動以及[[腺苷]]、[[雙嘧達莫]]等血管擴張劑都可以造成冠狀動脈竊流。擴張了的正常動脈血液量和流速都會增加，梗死或缺血的組織則會呈現較小的變化。<ref>{{cite web|title=Pharmacologic Stress Testing|url=http://emedicine.medscape.com/article/1827166-overview|author=Akinpelu, David|publisher=Medscape|accessdate=2014-03-21}}</ref>這種血液重組現象是缺血性[[冠心病]]的徵兆。通過比對負荷前後的鉈分佈情況，可以判斷需要進行心肌[[血管重建術]]的組織部份。<ref name=GJTaylor/>

===其他用途===

一種汞鉈合金在鉈含量為8.5%時形成[[共晶系統]]，其熔點為−60&nbsp;°C，比汞的熔點還要低20&nbsp;°C。這種合金被用於溫度計和低溫開關當中。<ref name=CRC/>在有機合成方面，鉈(III)鹽（如三硝酸鉈和三乙酸鉈）可以為[[芳香烴]]、[[酮類]]、[[烯烴]]等的轉化反應作試劑。<ref>{{cite journal|pages = 956–960|doi =10.1021/ar50034a003|title = Thallium in organic synthesis|year = 1970|last1 = Taylor|issue = 10|first1 = Edward Curtis|last2 = McKillop|first2 = Alexander|journal = Accounts of Chemical Research|volume = 3}}</ref>鉈是[[鎂]]海水電池[[陽極]]板的合金材料成份之一。<ref name="sl2001"/>可溶鉈鹽加入[[鍍金]]液中，可以加快鍍金速度和降低鍍金層的粒度。<ref>{{cite book | url = http://books.google.com/books?id=hDwX3slSvQ4C&pg=PA113 | pages = 113–115 | title = Integrated circuit, hybrid, and multichip module package design guidelines: a focus on reliability | isbn = 978-0-471-59446-8 | author1 = Pecht, Michael | date = 1994-03-01}}</ref>

甲酸鉈(I)（Tl(CHO<sub>2</sub>)）和丙二酸鉈(I)（Tl(C<sub>3</sub>H<sub>3</sub>O<sub>4</sub>)）的等量混合水溶液稱為[[克列里奇溶液]]（Clerici solution，亦稱輕重礦分離液）。它是一種無臭液體，顏色會隨鉈鹽濃度的降低而從黃色變為清澈。溶液在20&nbsp;°C密度為4.25&nbsp;g/cm<sup>3</sup>，是已知最重的水溶液之一。人們利用礦物在克列里奇溶液上漂浮的原理，測量各種礦物的密度。然而由於鉈的毒性和溶液的腐蝕性，這種方法逐漸被淘汰了。<ref name=jahns>{{cite journal|title=Clerici solution for the specific gravity determination of small mineral grains|url= http://www.minsocam.org/ammin/AM24/AM24\_116.pdf| volume=24|page=116 |year=1939|author=Jahns, R. H. |journal=American mineralogist}}</ref><ref name=b1>{{cite book |url=http://books.google.com/?id=tfXa13uWiRIC&pg=PA63|pages=63–64|title=Gemmology|author=Peter G. Read |publisher=Butterworth-Heinemann |year=1999|isbn=0-7506-4411-7}}</ref><!--

http://books.google.com/books?id=v-04Kn758yIC&pg=PA108

Chemistry of aluminium, gallium, indium, and thallium Von Anthony John Downs Uses of ThalliumSpringer, 19939780751401035

http://books.google.com/books?id=fIu58uZTE-gC&pg=PA390 Structure-property relations in nonferrous metals Von Alan M. Russell,Kok Loong Lee 9780471649526John Wiley and Sons, 2005

http://minerals.usgs.gov/minerals/pubs/commodity/thallium/mcs-2010-thall.pdf

10.1016/j.envint.2004.09.003

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碘化鉈可以添加在[[金屬鹵化物燈]]中，優化燈的溫度和顏色。<ref>{{cite journal|doi=10.1364/JOSA.54.000532|title=Characteristics of Mercury Vapor-Metallic Iodide Arc Lamps|year=1964|last1=Reiling|first1=Gilbert H.|journal=Journal of the Optical Society of America|volume=54|issue=4|page=532}}</ref><ref>{{cite journal|doi=10.1364/AO.6.001563|title=The Effect of Thallium Iodide on the Arc Temperature of Hg Discharges|year=1967|last1=Gallo|first1=C. F.|journal=Applied Optics|volume=6|issue=9|pages=1563–5|pmid=20062260|bibcode = 1967ApOpt...6.1563G }}</ref>它可以使燈光靠近綠色，這對水底照明非常有用。<ref>{{cite news|url=http://www.nytimes.com/1987/08/11/science/undersea-quest-for-giant-squids-and-rare-sharks.html?pagewanted=all&src=pm |title=UNDERSEA QUEST FOR GIANT SQUIDS AND RARE SHARKS|author=Wilford, John Noble|date=1987-08-11}}</ref>

==毒性及污染==

{{main|鉈中毒}}

鉈及其化合物毒性極高，在處理時的安全措施需格外嚴格。迄今已有多件因鉈中毒而死亡的案例。<ref>[http://www.nj.com/news/index.ssf/2011/02/thallium\_is\_favored\_method\_of.html A 15-year-old case yields a timely clue in deadly thallium poisoning]. NJ.com (2011-02-13). Retrieved on 2013-09-03.</ref>鉈需避免與皮膚接觸，而在熔化鉈金屬時，也需保證充分的通風。鉈(I)化合物的水溶性高，可以輕易透過皮膚吸收。根據[[美國勞工部]]，鉈的允許暴露限值為，平均8小時內每平方米不超過0.1毫克。<ref>[https://www.osha.gov/dts/chemicalsampling/data/CH\_271500.html Chemical Sampling Information | Thallium, soluble compounds (as Tl)]. Osha.gov. Retrieved on 2013-09-05.</ref>經皮膚進入體內的鉈可以超過經呼吸吸收的量。<ref>[https://www.osha.gov/SLTC/surfacecontamination/ Safety and Health Topics | Surface Contamination]. Osha.gov. Retrieved on 2013-09-05.</ref>鉈對於人類是一種懷疑[[致癌物]]。<ref name="WebEl">{{cite web|url = http://www.webelements.com/webelements/elements/text/Tl/biol.html|title = Biology of Thallium|publisher = webelemnts| accessdate = 2008-11-11}}</ref>由於毒性高、幾乎無味、可溶於水，所以歷史上因意外或犯罪導致[[鉈中毒]]死傷的案例並不鮮見。<ref name="Murder"/>

從人體移除鉈元素的方法之一是使用能夠吸收鉈的[[普魯士藍]]。<ref>{{cite journal|last1=Yang|first1=Yongsheng|last2=Faustino|first2=Patrick J.|last3=Progar|first3=Joseph J.|last4=Brownell|first4=Charles R.|last5=Sadrieh|first5=Nakissa|last6=May|first6=Joan C.|last7=Leutzinger|first7=Eldon|last8=Place|first8=David A.|last9=Duffy|first9=Eric P.|last10=Yu|first10=Lawrence X.|last11=Khan|first11=Mansoor A.|last12=Lyon|first12=Robbe C.|title=Quantitative determination of thallium binding to ferric hexacyanoferrate: Prussian blue|year=2008|journal=International Journal of Pharmaceutics|volume=353|issue=1–2|pages=187–194|doi=10.1016/j.ijpharm.2007.11.031|pmid = 18226478|display-authors=3}}</ref>病人每天需口服最多20克普魯士藍，藥物通過[[消化系統]]後經糞便排出體外。[[血液透析]]和[[血液灌流]]方法也可以把鉈從血液中移除。在治療的後期階段，病人需服用額外的鉀，把鉈從組織中帶出來。<ref>[http://www.bt.cdc.gov/radiation/prussianblue.asp Prussian blue fact sheet]. US [[Centers for Disease Control and Prevention]]</ref><ref>{{cite journal|last = Malbrain|first = Manu L. N. G.|coauthors = Lambrecht, Guy L. Y.; Zandijk, Erik; Demedts, Paul A.; Neels, Hugo M.; Lambert, Willy; De Leenheer, André P.; Lins, Robert L.; Daelemans, Ronny;|year = 1997|title = Treatment of Severe Thallium Intoxication|journal = Clinical Toxicology|volume = 35|issue = 1|pages = 97–100|doi = 10.3109/15563659709001173|pmid = 9022660}}</ref>

根據[[美國國家環境保護局]]（EPA），鉈的人為污染源包括[[水泥]]工廠所排放的氣體、發電廠所燃燒的煤以及金屬下水道。礦物加工時對鉈進行淋溶的過程是造成水源中鉈含量增高的主要原因。<ref name="Vira"/><ref>{{cite web| url = http://www.epa.gov/safewater/pdfs/factsheets/ioc/thallium.pdf|accessdate = 2009-09-15| title = Factsheet on: Thallium|publisher=US Environmental Protection Agency}}</ref>

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{{Reflist|colwidth=30em}}

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\* [http://www.emedicine.com/emerg/topic926.htm Toxicity, thallium]

\* [http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@na+@rel+thallium,+elemental NLM hazardous substances databank&nbsp;– Thallium, elemental]

\* [http://www.atsdr.cdc.gov/tfacts54.html ATSDR – ToxFAQs]

\* [http://www.cdc.gov/niosh/npg/npgd0608.html CDC - NIOSH Pocket Guide to Chemical Hazards]

{{元素週期表}}

[[Category:铊| ]]

[[Category:硼族元素]]

[[Category:第6周期元素|6a]]

[[Category:化学元素|6a]]

{{Link FA|el}}

{{Link GA|en}}