

Chinese Names of New Elements with $Z = 113, 115, 117$ & 118

Shan-Gui Zhou (周善贵/周善貴)¹

Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing 100190, China

(中国科学院理论物理研究所/中國科學院理論物理研究所)

sgzhou@itp.ac.cn

1. Introduction

After the 4th Joint IUPAC/IUPAP Working Party confirmed the discovery of the elements with $Z = 113, 115, 117$ and 118 [1], the naming process of these new elements was officially started. In the end of November 2016, IUPAC announced the new names and symbols: nihonium (Nh) for element 113, moscovium (Mc) for element 115, tennessine (Ts) for element 117 and oganesson (Og) for element 118 [2]. In July 2017, the Council of the IUPAC ratified these names and symbols [3].

Several tens of languages have been used to translate element names [4,5]. In most of these languages, Latin scripts (letters) or native writing systems (syllable characters), e.g., *Katakana* in Japanese, are used for the element names. However, we use the Chinese characters or scripts (*Kanji*) in China [6].

In 1932, the Ministry of Education of China announced the Chinese names for 89 elements, covering the elements from hydrogen to uranium with exceptions for astatine, francium and protactinium [7]. Since then, more than ten announcements have been officially made concerning Chinese names of the elements. Although there were some strong objections against creating new characters and there were also some different proposals concerning how to represent an element in Chinese [7], e.g., to simply use Latin names, to use phonetic transcription or to use two or more characters, now it has been well established that one Chinese character should be chosen or, if necessary, created for an element. The

¹ In this article, a person's name, the name of an institution, the name of a book or a term in English is followed by the Chinese names included in parentheses. For a person's name in English (Chinese), the given name is followed by (follows) the surname. Whenever the simplified and traditional characters are different, both are given and separated by a slash.

reason behind doing so might be that, as Professor Ning Wang (王宁/王寧), a linguist in Beijing Normal University (北京师范大学/北京師範大學), says, “The elements themselves are of science, but naming them (and their names) are also of humanities” [8].

In this article, I will introduce the naming of the elements with Chinese, in particular the Chinese names of the new elements with $Z = 113, 115, 117$ and 118 . In Section 2, I will briefly discuss about how to name elements in Chinese and some general rules. The Chinese names of four new elements will be given and explained in Section 3. In Section 4, I will give a summary.

2. How to name elements in Chinese and some general rules

The naming of the elements in Chinese must not only follow strictly the internationally recognized names, i.e., those ratified by IUPAC, but also reflect the features of Chinese as a language and Chinese characters [8]. In China, the National Committee for Terms in Sciences and Technologies in the Mainland and the Committee for Terms in Chemistry of National Academy of Educational Research in Taiwan are responsible for the naming of new elements, the former mainly for names with simplified characters and the latter mainly for those with traditional characters.

In an etymological dictionary *Shuowen Jiezi* (说文解字/說文解字) by Shen Xu (许慎/許慎) in Han Dynasty, the Chinese characters were classified into six categories, the so called “Six Writings (六书/六書)”. The most easily understandable ones may be *pictographs* (象形文字), e.g., the sun (日) is ☉ in the oracle bone script (甲骨文/甲骨文) and the wood or tree (木) is 𣎵 in the oracle bone script. The mostly used ones are, however, *signific-phonetic* characters [9] or *phono-semantic* compounds [10] (形声字/形聲字). A signific-phonetic character consists of a signific (semantic) radical and a phonetic radical, the former representing the thing and the latter the sound [9]. There are also many ideographs (会意字/會意字), consisting of two or more pictographs to express a new meaning, e.g., the forest (林) is 𣏟 (many trees) in the oracle bone script.

Except several characters which were traditionally used for known elements, e.g., gold (金) and iron (铁/鐵), the Chinese names of the elements are basically signific-phonetic characters yet borrowing, to different extent, some ideographic ideas. Since 1932, there has been a convention that four signific radicals should be used for naming the elements, depending on the state of matter of the respective element at room temperature: “气” for gases; “氵” (from 水 and meaning water) for liquid; “石” (meaning stone) and “钅/金” (from 金 and meaning gold or metal) for non-metallic and metallic solids, respectively. This convention is actually in accord with the IUPAC recommendations [11]: “The names of all

new elements should have an ending that reflects and maintains historical and chemical consistency. This would be in general ‘-ium’ for elements belonging to groups 1–16 (of the periodic table), ‘-ine’ for elements of group 17 and ‘-on’ for elements of group 18.” According to this convention, for the elements discovered in recent years, the following rules can be derived: The signific radical “钅/金” is for elements belonging to groups 1–16 of the periodic table, “石” for elements of group 17 and “气” for elements of group 18.

With the signific radical fixed, the rest of naming an element in Chinese is to find a proper phonetic radical which is undertaken with three ways [8]. The first way is to use an existing character which has a meaning similar or close to the element. One example is “碳” for carbon: the signific radical is “石” and the phonetic part is “炭” which means the rest after burning the wood, according to *Shuowen Jiezi*; the pronunciation of “碳” follows exactly “炭”, i.e., [tan, the 4th tone]². The second way is to choose an existing character or radical which tells a certain feature of the element. For example, “氢/氫” for hydrogen is from the signific radical “气” and the phonetic radical of “轻/輕” which means being light, a feature of the hydrogen gas. The pronunciation of “氢/氫” is the same as “轻/輕”, i.e., [qing, the 1st tone]. The third way is to choose an existing character or radical the pronunciation of which is similar to one of the syllables (preferably the first one) of the English name of an element. Most of the elements, including the four new ones, were named in the third way in Chinese.

There are some other rules when choosing an existing character or radical for naming an element [12,13,14]: (1) Unless extremely necessary, no new characters should be created; (2) The pronunciation of the Chinese character of a new element should differ as much as possible from those of existing ones; (3) A character having less strokes is more preferable; (4) A character which was not simplified is more preferable; (5) Characters which are being used in daily life or as scientific terms should be avoided; (6) Characters which were used for naming elements but now obsolete should not be used again for a new element.

3. Chinese names of the new elements with $Z = 113, 115, 117$ & 118

After the IUPAC announced the new names and symbols for the elements with $Z = 113, 115, 117$ and 118 , the naming of these elements in Chinese was started soon. Lots of discussions have been made before the final solution was given [15]. The Chinese names for nihonium, moscovium, tennessine and oganesson are “钅/鈹”, “钅/鎊”, “砷” and “氮/氮”, respectively [16,17]. Among them, “钅/鈹”, “砷” and “氮/氮” are newly created. These Chinese names are widely supported by the Chinese physicists [18,19], chemists [20] and linguists

² When necessary, the *Hanyu Pinyin* (Chinese phonetic alphabet) of a character is given in square brackets to tell how this character is pronounced.

[8,14,21], though there are also some different opinions mainly for element 113 which I will mention later [21].

3.1. The element with $Z = 113$: nihonium (Nh), 鉈

According to the convention lasted for more than eighty years, the signific radical for nihonium (Nh) should be “钅/金”. The character “鉈/鉈” was chosen for the Chinese name of the element nihonium (Nh) with $Z = 113$. In fact, there is only traditional form for this character, i.e., “鉈” and one has to simplify it into “鉈” for modern use in the Mainland China. Thus “鉈” is a newly created character. There are three pronunciations for “鉈” and the most popular one, [ni, the 3rd tone], was assigned to the element Nh. This pronunciation is very similar to the first syllable of nihonium; this is one of the important reasons why “鉈/鉈” was chosen. Other reasons include: (1) “鉈/鉈” is quite simple and easily written; (2) It has not been used very much in modern Chinese though the author of Ref. [21] does not agree, see below; (3) Its pronunciation is the same as that of “你” which means “you” and is very often used, therefore “鉈/鉈” is easily read because when seeing it, one may most probably pronounce “鉈/鉈” in analogy with “你”.

Some people are strongly against “鉈/鉈” for the element Nh. The main reasons are the following [21]: (1) As mentioned before, “鉈” has three pronunciations and this may cause confusions; (2) The pronunciation now adopted for nihonium is similar to that of an existing Chinese name, “铈/铈” [ni, the 2nd tone] for the element niobium (Nb); (3) One of the meanings of “鉈”, the stamp of the emperor, is used widely in archeology.

There were several other proposals for the Chinese name of nihonium. Having in mind that the name for element 113, nihonium, is proposed to make a direct connection to Japan where this element was discovered, many people (including me) suggested “钶/钶” for the Chinese name of nihonium. “钶/钶” consists of the signific radical “钅/金” and the first character of the Chinese name of Japan “日本国/日本國”. But this suggestion was rejected because (1) the pronunciation of “钶/钶” in modern Chinese is very different from any syllables of nihonium and (2) “钶” was created many years ago for naming germanium and later for naming radium but was finally abandoned. Another proposal is “铉/铉” which exists. Its pronunciation is [hong, the 2nd tone] which is similar to the second syllable of nihonium, because of which, it was not accepted either.

3.2. The element with $Z = 115$: moscovium (Mc), 镆

The signific radical for moscovium (Mc) is also “钅/金”. The phonetic radical should follow the pronunciation of moscovium. “莫斯科” is the transliterated name in Chinese for

Moscow in recognition of which moscovium is proposed for element 115. The first Character “莫” is pronounced as [mo, the 4th tone] which is similar to the first syllable of Moscow. It happens that there is a Chinese character “镆/鏌” consisting of “钅/金” and “莫”. “镆/鏌” only appears in the word “镆铷/鏌铷”, solely used to represent a legendary sword. The pronunciation of “镆/鏌”, [mo, the 4th tone], is the same as that of “莫” and close to the first syllable of moscovium. Therefore it is very natural to use “镆/鏌” for the Chinese name of this element.

3.3. The element with $Z = 117$: tennessine (Ts), 𧈧

The signific radical for tennessine (Ts) should be “石”. The phonetic radical should follow the pronunciation of the name of element 117 tennessine which is recommended in recognition of the contribution of the Tennessee region in the United States of America to the study of superheavy elements. The transliterated name of Tennessee in Chinese is “田纳西” with the first Character “田”. By putting “石” and “田” together, a new Chinese character “𧈧” is then created and used as the Chinese name of the element tennessine. The pronunciation of “𧈧” follows that of “田”, [tian, the 2nd tone], which is similar to the first syllable of tennessine.

3.4. The element with $Z = 118$: oganesson (Og), 𧈨/𧈩

Oganesson belongs to group 18 and thus its signific radical should be “气”. Oganesson is proposed in recognition of Professor Yuri Tsolakovich Oganessian for his pioneering contributions to transactinide elements research. Oganessian is transliterated into Chinese as “奥加涅相/奥加涅相” with the first Character “奥/澳” pronounced similarly to the first syllable of Oganessian. It was not possible to find an existing Chinese character both with the signific radical being “气” and with a proper pronunciation. Therefore a new character “𧈨/𧈩” was created by combining “气” and “奥/澳” together. Its pronunciation [ao, the 4th tone] follows that of “奥/澳” and is similar to the first syllable of oganesson.

4. Summary

In this article, I have briefly discussed the naming of elements in Chinese, including how to choose or create a proper Chinese character and some general rules. Then the Chinese names of four new elements were introduced, namely, “铈/铈” for nihonium (Nh), “镆/鏌” for moscovium (Mc), “𧈧” for tennessine (Ts) and “𧈨/𧈩” for oganesson (Og).

Before I finish, I'd like to mention that the Chinese names of the elements are usually used in the text, and the symbols are often used in equations for chemical or nuclear reactions.

Let me give two examples: (1) “Hydrogen and oxygen react to form water” is “氢和氧反应生成水/氢和氧反应生成水” in Chinese, one can also say “H₂ 和 O₂ 反应生成水/H₂ 和 O₂ 反应生成水”, but for the chemical equation, we use “2H₂ + O₂ → 2H₂O”; (2) “Scientists produced ²⁷⁸Nh by bombarding ⁷⁰Zn on ²⁰⁹Bi” is in Chinese “科学家用锌-70 轰击铋-209 生成铈-278/科学家用锌-70 轰击铋-209 生成铈-278” or “科学家用 ⁷⁰Zn 轰击 ²⁰⁹Bi 生成 ²⁷⁸Nh/科学家用 ⁷⁰Zn 轰击 ²⁰⁹Bi 生成 ²⁷⁸Nh”, but the equation of the reaction reads “⁷⁰Zn + ²⁰⁹Bi → ²⁷⁸Nh + 1n”.

Though the 7th period of the periodic table of elements is complete, yet it is very likely (and I hope) that this is not for the table itself. I am looking forward to new superheavy elements beyond that with Z = 118, i.e., oganessian (Og).

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