Comparative Studies of Element Periodic Table and Tables in Element Periodic Table

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Abstract: As No.1 of comparative chemistry series papers, running the comparative studies between the element periodic table and the concepts of “fractal in fractal”, “sub-library in library”, and the like, and reaching the concept of “tables in element periodic table”. Then, some special forms of “tables in element periodic table” are discussed. Also pointing out that in the big data analysis of chemical elements, “tables in element periodic table” will have a good prospect.
Key words: Comparative chemistry, comparative study, element periodic table, table in table, tables in element periodic table, big data analysis

Introduction

In reference [1], the concept of comparative chemistry is proposed. As one of comparative chemistry series papers, running the comparative studies between the element periodic table and the concepts of “fractal in fractal” proposed in reference [2], “sub-library in library” proposed in reference [3], and the like, and reaching the concept of “tables in element periodic table”. On this basis, some special problems related to “tables in element periodic table” are discussed.

1 The concepts of “fractal in fractal”, “sub-library in library”, and the like

The concept of “fractal in fractal” is as follows.

Recently, fractal method has been successful used in many fields, it is used for opening out the deeply hidden organized structure in the complex phenomenon. The quantity for reflecting the character of organized structure is called the fractal dimension, expressed with the value of D. In the fractal methods for general application at present, the fractal dimension D is a constant, for example the values of fractal dimension D for different coastlines may be taken as 1.02, 1.25 and so on.

The fractal model reads

$$N = \frac{C}{r^D} \tag{1}$$

where: r is the characteristic scale, such as time, length, coordinates and so on; N is the object number or quantity related with the value of r, such as atomic weight, density, temperature, and so on; C is a constant to be determined, D is the fractal dimension.

In the general application of fractal method at present, D is the constant, this kind of fractal may be called constant dimension fractal. It is a straight line in the double logarithmic coordinates. According to arbitrary two data points (N_i, r_i) and (N_j, r_j) on this straight line, the fractal parameters of this straight line, i.e., the fractal dimension D_{ij} and the constant C_{ij}, can be determined; in fact, substituting the coordinates of the two data points into Eq.(1), they can be solved

$$D_{ij} = \frac{\ln(N_i / N_j)}{\ln(r_j / r_i)} \qquad (2)$$

$$C_{ij} = N_i r_i^{D_{ij}} \qquad (3)$$

For the straight line functional relation in the double logarithmic coordinates, it is able to process the prediction and calculation with the constant dimension fractal directly.

But for the non-straight line functional relation in the double logarithmic coordinates, it is unable to process the prediction and calculation with the constant dimension fractal. Many questions are belonging to this situation. In order to overcome this difficulty, we introduced the concept of variable dimension fractal in references [4-6], namely the fractal dimension D is the function of characteristic scale r.

$$D = F(r) \qquad (4)$$

The “fractal in fractal” proposed in reference [2] is one kind of variable dimension fractal, and its fractal dimension D is as follows

$$D = \frac{C^{'}}{r^{D'}} \qquad (5)$$

In this paper we propose another kind of variable dimension fractal, namely the characteristic scale r is expressed with the fractal form as follows

$$r = \frac{C^{''}}{r'^{D''}} \qquad (6)$$

The concept of “sub-library in library” is as follows.

In the concept of “sub-library in library” proposed in reference [3], the concept of "library" is the promotion of the concept of generalized and hybrid set, and the concept of “sub-library” is the promotion of the concept of "subset". For example, for the "information library of natural sciences", its “sub-libraries” include: “information sub-library of mathematics”, “information sub-library of physics”, “information sub-library of chemistry”, “information sub-library of biology”, and the like.

Similarly, we can also discuss the concepts of "subjects in subject" and the like. For example, the "chemistry" includes: biochemistry, organic chemistry, polymer chemistry, applied chemistry, inorganic chemistry, physical chemistry, chemical engineering, and other branches.

2 The concept of “tables in element periodic table”

Firstly, running the comparative studies between the element periodic table and the concepts of “fractal in fractal”, “sub-library in library”, and the like.

There are many same points between the element periodic table and the concepts of “fractal in fractal”, “sub-library in library”, and the like. In which, the most important two same points are as follows.

The first same point: like the concepts of “fractal in fractal”, “sub-library in library”, and so on, the element periodic table also occupies a very important position. In fact, the element periodic table is the core of chemistry. Therefore, it also needs to be improved and promoted constantly.

The second same point: like the concepts of “fractal in fractal”, “sub-library in library”, and so on, the element periodic table should be able to include vast amounts of information, but currently the element periodic table cannot do that.

Based on the above analysis and study, referring to the concepts of “fractal in fractal”, “sub-library in library”, and so on, it is clear that the following decision can be drawn: to establish “tables in element periodic table”, is an effective way to improve and promote the element periodic table.

How to establish “tables in element periodic table”? In addition to comparing with the effective practices in the concepts of “fractal in fractal”, “sub-library in library”, and so on, we can also compare with the effective practices in the element periodic table itself.

As well-known, in the general case, in the element periodic table, one grid includes only one element; but for the lanthanides and actinides, 15 elements are jointly occupy one grid. In other words: the element periodic table itself includes the form of "table in table". However, for this case of the lanthanides and actinides, one grid includes only one table, namely the table of 15 elements of the lanthanides, and the table of 15 elements of the actinides (see Table 1 and Table 2).

Table 1. 15 elements of the lanthanides

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu

Table 2. 15 elements of the actinides

Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

On this basis, there can be a variety of ways to extend the original form of "table in table". For example, for one grid in “tables in element periodic table”, it can include a series of tables associated with the element, such table may be referred to: the table associated with an element. In addition, the information about several elements can also be combined to form one or more tables, such table may be referred to: the table associated with several elements.

3 Examples of “tables in element periodic table”

The table associated with an element.

Example 1，two or more isotopes of the same chemical element with identical atomic number, occupy the same position in the element periodic table.

Example 2, the basic properties of hydrogen are shown in table 3.

Table 3, the basic properties of hydrogen

State of matter: gas
Element content in the Sun: 75%
Element content in the Earth' crust: 1.5%
Content of the atmosphere: 0.0001 %
Proton relative mass: 1.00794
Belongs to cycle: 1
Belongs to family: IA
Molecular weight: 1g/mol
Oxides: H_2O
Highest oxide: H_2O

The table associated with several elements.

Example 3，the main properties of halogen simple substances are shown in table 4.

Table 4, the main properties of halogen simple substances

simple substance	color and state	density	melting point/℃	boiling point/℃
F_2	pale yellow-green gas	1.69g/L(15℃)	-219.6	-188.1
Cl_2	yellow-green gas	3.214g/L(0℃)	-101	-34.6
Br_2	deep reddish brown liquid	3.119g/cm^3(20℃)	-7.2	58.78
I_2	purple-black solid, purple gas	4.93g/cm^3(15℃)	113.5	184.4

4 The “tables in element periodic table” and the big data analysis

With the advent of the age of big data, the big data analysis have emerged, and it is becoming an increasingly important tool.

After expanding the element periodic table into a variety of “tables in element periodic table”, the vast amounts of information can be included, thus will provide the great conveniences for the big data analysis of chemical elements.

It should be noted that, in the big data analysis of chemical elements, the fractal method will play an increasingly important role.

5 Conclusions

Based on the comparative studies of the element periodic table, it can be expanded into “tables in element periodic table”. Because the vast amounts of information can be included, the “tables in element periodic table” will have a good prospect for the big data analysis of chemical elements. In addition, the fractal method will play an increasingly important role for the big data analysis of chemical elements.

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