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Journal of Organometallic Chemistry 611 (2000) 3–4

Journal of Organometallic Chemistry

Editorial

Introduction to The Chemistry of Interelement Linkage

1. Special notes on the chemistry of interelement linkage

As described in the Preface, the new term 'interelement linkage' has been introduced for chemical bonds such as mutual linkages within the heavy main group elements and linkages between the main group elements and the transition metals. Many persons may say that all compounds have element–element bonds. We know it is true, of course. However, our terminology is based on the Russian-original term 'elemento–organic compounds' for organic compounds of heavy main group elements. During the last two decades, this term has been recognized world wide. In this context, we have introduced the new term 'interelement linkage'.

We have mainly investigated the chemistry of interelement linkage from the organic chemistry side. One of the representative examples of the interelement *satu-*

Table 1
The CCDC data numbers of organic compounds containing each interelement linkage surveyed in March 2000

	B	Al	Ga	In	Tl	Si	Ge	Sn	Pb	P	As	Sb	Bi	S	Se	Te
B	1951															
Al	11	63														
Ga	14	0	45													
In	4	0	0	29												
Tl	4	0	0	0	14											
Si	29	21	28	4	1	677										
Ge	16	0	1	0	0	48	90									
Sn	34	1	0	0	0	25	8	103								
Pb	7	0	0	0	0	6	3	0	19							
P	348	69	91	78	2	349	37	48	9	912						
As	24	20	39	13	0	85	2	7	0	24	196					
Sb	4	1	4	4	0	14	1	3	0	13	0	79				
Bi	0	1	0	0	0	4	3	1	0	9	0	0	25			
S	235	48	59	115	76	106	103	429	108	1012	145	152	141	2012		
Se	19	11	13	38	8	23	26	72	9	102	41	18	8	65	446	
Te	18	6	12	15	2	41	7	34	3	9	13	6	0	250	56	212

PII: S0022-328X(00)00544-1

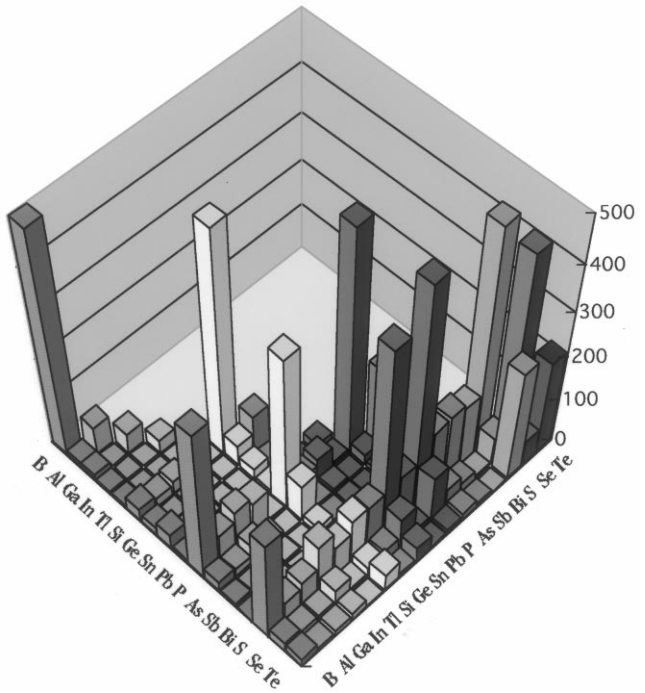

Fig. 1. A graphical presentation of the crystallographic data numbers of organic compounds having some representative interelement linkages.

rated linkage is the Si–Si single bond in the polysilane chemistry which was developed by M. Kumada in Japan in the mid 1950s [1]. The chemistry of interelement *unsaturated* compounds has been opened in 1981 by R. West [2] and M. Yoshifuji [3] who introduced a new concept of kinetic stabilization by the use of bulky substituents for isolation of otherwise highly reactive Si–Si and P–P double bonds, respectively. Since then, a variety of interelement multiply bonded compounds have been prepared [4].

There are some important characteristic features in the chemistry of interelement linkage. First, in comparison with the traditional carbon–element bonds, the interelement σ-bond electrons are generally of higher energy and of higher mobility, and the π-bond electrons are far more reactive. Second, there are a variety of combinations of elements: for example, the number of just a two-element combination exceeds 1400; this number may be compared with about 85 for the carbon–element linkage in traditional organic chemistry. If we consider a variety of possibilities for saturated, unsaturated, coordination, oxidation numbers, etc. there may be infinite possibilities. Third, interelement organic compounds must be created through the scientists' wisdom, because there are no naturally occurring interelement organic compounds, except a few examples such as the biologically important S–S bond. Thus, we recognize this research field as very challenging.

2. The present and future of the chemistry of interelement linkage

In order to get a piece of information of the current research trends in the organic chemistry of interelement linkage, we have surveyed the X-ray structure data deposited at the Cambridge Crystallographic Data Centre (CCDC). The data survey was restricted to 'organic compounds' containing 'interelement linkage' between 16 elements of Group 13–16 except for C, O, and N. The data obtained in March 2000 are listed in Table 1 and visualized in Fig. 1.

The top ten are in the following order, the data number being listed in the parentheses: S–S (2012) > B–B (1951) > P–S (1012) > P–P (912) > Si–Si (677) > Se–Se (446) > Sn–S (429) > Si–P (349) ≥ B–P (348) > S–Te (250); the high rank of the B–B linkage is ascribed to the carbaborane (carborane) chemistry. It is noted that within the 16 elements surveyed, only four elements, Si, P, S, and Se, have interelement organic compounds of all combinations, while more than 20 combinations have no structural information of the interelement linkage. It is beyond question that the interelement linkages consisting of the former, rather 'popular' elements are of great interest, but compounds having the latter barely-investigated interelement linkages are also worthy of future investigation.

References

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