Electron Configurations

The content that follows introduces the discussion of Quantum Numbers and their use in Electron Configurations as well as the relationship between electron configurations and periodic properties of elements. Furthermore, it illustrates how MatDeck software is used to obtain an electronic configuration.

Electron configurations are simple descriptions of where the electrons are around a nucleus. Each neutral atom has a number of electrons equal to its number of protons. Those electrons are placed into an arrangement around the nucleus that indicates their energy and the shape of the orbital in which they are located. Here is a summary of the types of orbitals and how many electrons each can contain:

Orbitals and Electron Capacity of the First Four Principle Energy Levels				
Principle energy level (n)	Type of level	Number of orbitals per type	Number of orbitals per level (n^2)	Maximum number of electrons ($2n^2$)
1	s	1	1	2
2	s	1	4	8
	p	3		
3	s	1	9	18
	p	3		
	d	5		
4	s	1	16	32
	p	3		
	d	5		
	f	7		

Using the quantum numbers and the chart above, we know that we need 2 electrons to fill an s orbital; 6 electrons to fill a p orbital; 10 electrons to fill a d orbital and 14 electrons to fill s f orbital. The order in which electrons are placed into the orbitals is based on the order of their energy. This is referred to as the Aufbau principle. The lowest energy orbitals fill first, just like the quantum numbers themselves. This order is determined by a calculation and is summarized by the following chart.

However, we can easily obtain the electronic configuration of any element by using the function *chem_electronic_configuration()* from the Chemistry toolbox in MatDeck, or the Periodic Table Tool. If the function *chem_electronic_configuration()* is used, the argument is a chemical symbol or quantum number of an element.

```
1   el_c_Pb := chem_electronic_config("Pb")
2   el_c_Mc := chem_electronic_config(115)
```

el_c_Pb = "1s2 2s2 2p6 3s2 3p6 3d10 4s2 4p6 4d10 5s2 5p6 4f14 5d10 6s2 6p2"

el_c_Mc = "1s2 2s2 2p6 3s2 3p6 3d10 4s2 4p6 4d10 5s2 5p6 4f14 5d10 6s2 6p6 5f14 6d10 7s2 7p3"

The second approach to see an electronic configuration of an element is to use the Periodic Table tool, which is accessed from the Toolbox menu. The Periodic Table is a graphical intuitive tool that can also export data as variables. For example, the following electronic configuration is extracted from the Periodic

Table: *Al := "[Ne] 3s2 3p"*. The same can be added to MatScript code as a variable:

```
3   Si := "[Ne] 3s2 3p2"
```

An electronic configuration added from the Periodic Table tool will be in the form of a shortcut. When writing some of the lower table configurations, the total configuration can be fairly long. The Periodic table uses the previous noble gas to abbreviate the configuration as shown above. If the complete configuration is needed, the function *chem_electronic_configuration()* can be used as explained above.

Finally, here is a chart that illustrates how orbitals are filled, in the periodic table