Inert pair effect of tin and lead

pranjoto utomo

- Inert pair effect occurs when electrons are pulled closer to the nucleus, making them more stable and more difficult to ionize.
- An electron around the nucleus requires sufficient kinetic energy in order not to be pulled towards the nucleus.

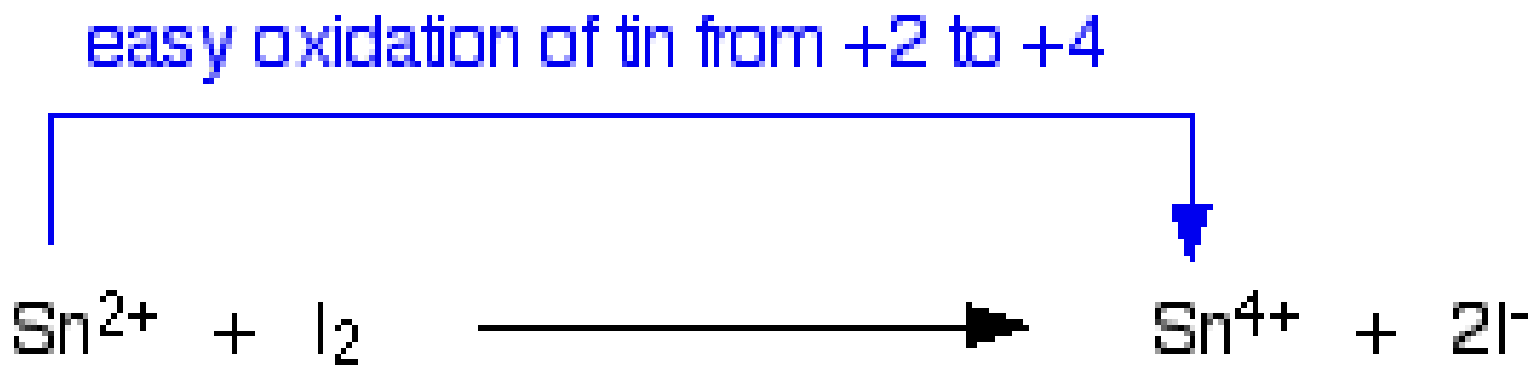
- This results in it having higher speeds, with a higher force acting on it by the nucleus.
- The effects for the heavier elements are appreciable, as electrons travel closer to the speed of light, *c*.
- The s-orbital electrons are more affected in this way since they have a greater penetrating power.

- The inert pair effect is apparent from the chemistry of the Group III and Group IV elements and beyond.
- The lighter elements in Group IV tend to have a oxidation state of +4, whereas the heavier elements form 2+ ions that are more stable than 4+ ions.

- $_{50}Sn = [_{36}Kr]\ 4d^{10}\ 5s^2\ 5p^2$
  - $EI_1 = 0{,}7086\ kJmol^{-1}$
  - $EI_2 = 1{,}4118\ kJmol^{-1}$
  - $EI_4 = 3{,}9303\ kJmol^{-1}$

- That means that it will be fairly easy to convert tin(II) compounds into tin(IV) compounds. This is best shown in the fact that Sn^{2+} ions in solution are good reducing agents.

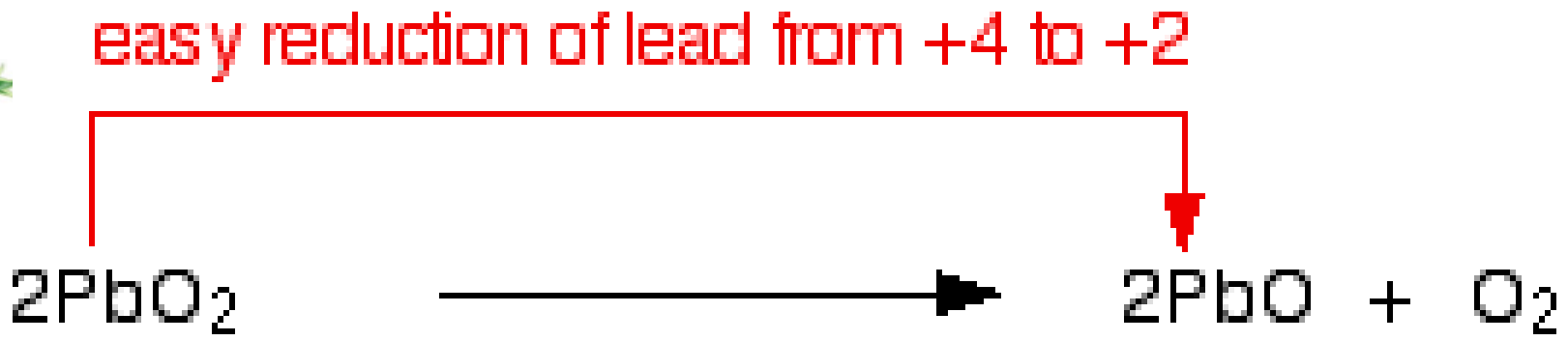
- For example, a solution containing tin(II) ions (for example, tin(II) chloride solution) will reduce a solution of iodine to iodide ions. In the process, the tin(II) ions are oxidised to tin(IV) ions.



- $_{82}Pb = [_{54}Xe]\ 4f^{14}\ 5d^{10}\ 6s^2\ 6p^2$
  - $EI_1 = 0{,}7155\ kJmol^{-1}$
  - $EI_2 = 1{,}4505\ kJmol^{-1}$
  - $EI_4 = 4{,}0830\ kJmol^{-1}$

- That means that it will be fairly easy to convert lead(IV) compounds into lead(II) compounds. This is best shown in the fact that Pb^{4+} ions in solution are good oxidizing agents.

- For instance, PbO is much more stable than PbO_2 which decomposes readily to PbO



- Heavy elements in certain groups of the periodic table form compounds in which they exist with oxidation states two less than the common oxidation state for that group.
- For example, although the common oxidation state for elements in group 4 is +4, most elements in the group can also exist in oxidation state +2

- This is because of the inert pair effect. In large atoms, such as those of tin and lead, some outer-shell electrons are not as well shielded as those in the inner core.
- They are therefore sucked into the inner core of electrons and thus become inert.