5.5: Group 14 Metals

Of the ten isotopes of tin, Sn, ^{118}Sn (24.22%) and ^{120}Sn (33.59%) are the most abundant. Metallic tin is present as α tin (gray tin), which is stable below 13.2 °C and β tin which is stable at higher temperatures. At low temperatures, the phase transition is quick. Divalent and tetravalent compounds are common, and divalent compounds are reducing agents.

^{208}Pb (52.4%) is the most abundant among the four stable isotopes of lead, Pb. Lead is the end product of natural radioactive decay and has 82 protons. The atomic number 82 is important as it is especially stable. Thus, Pb exhibits high abundance for a heavy element. The divalent and tetravalent oxidation states are most common and usually lead is present as Pb^{2+} except in organometallic compounds. PbO_2 is a tetravalent compound and readily becomes divalent, hence it is a very strong oxidizing agent. Although tetraethyl lead was previously used as an anti-knock agent in gasoline, only unleaded gasoline is now permitted for use in Japan.

It has been known since the 1930s that when Ge, Sn, or Pb are reduced by sodium in liquid ammonia, multi nuclear anions such as Ge_9^{4-}, Sn_5^{2-}, and Pb_9^{4-}, are formed. These are called Zintl phases. These multi-atom anions we etc. recently using a cryptand, and cluster structures re crystallized as $[Na(crypt)]_4$ $[Sn_9]$ have been elucidated.

problems

5.1

Write a balanced equation for the formation of butyllithium.

5.2

Potassium permanganate is insoluble in benzene but it dissolves in this solvent in the presence of a crown ether which is a cyclic polyether. Why is the solubility of potassium permanganate increased in the presence of a crown ether?

5.3

Why is trimethylaluminum called an electron deficient compound?