### Stability of oxides

**Descending the group IV:**
- The +2 oxidation state becomes more stable
- The +4 oxidation state becomes less stable

### Tetrachloride

<table>
<thead>
<tr>
<th><strong>Formula</strong></th>
<th><strong>XCl₄</strong></th>
</tr>
</thead>
</table>
| **Structure** | • Molecular structure  
• All XCl₄ molecules held together in liquid state by weak Van der Waal’s forces  
• Low boiling points and liquid at room conditions |
| **Boiling points** | • Increases down the group  
• Molecules get larger, electron cloud is relatively easier to distort  
• Stronger Van der Waal’s forces  
• More energy required to overcome this force in order to boil |
| **Shape** | Tetrahedral shape with bond angle of 109.5° |
| **Thermal stabilities** | Down the group:  
• Thermal stabilities decrease  
• Covalent bond becomes weaker as the atoms get larger  
• Inert pair effect makes the +IV oxidation less stable down the group  

- **CCl₄** is stable to heat  
- **PbCl₄** is a yellow liquid which slowly decomposes at room temperature to lead (II) chloride and chlorine gas  
  \[ \text{PbCl}_4 \rightarrow \text{PbCl}_2 + \text{Cl}_2 \]  
  Yellow solid  
  White solid |
| **Hydrolysis with water** | 1. **CCl₄** does not react with water because a water molecule cannot form dative bond with the carbon atom as it does not have any vacant 3d orbitals.  
2. **SiCl₄** + **2H₂O** → **Si(OH)₄** + **4HCl**  
3. **GeCl₄** + **2H₂O** → **GeO₂ + 4HCl**  
4. **SnCl₄** + **4H₂O** → **Sn(OH)₄ + 4HCl**  
5. **PbCl₄** + **4H₂O** → **Pb(OH)₄ + 4HCl** |