

Answer on Question #53528 – Chemistry – Inorganic Chemistry

Question:

SbF₅ is known but BiF₅ is not known. Explain by giving orbital electronic configuration.

Answer:

The electronic configurations of the metals are:

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3$ for Sb

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^3$ for Bi.

Since Bi has $6s^2$, which has somewhat lower energy than $4f^{14} 5d^{10}$ it needs much energy to use these electrons for bond formation. Therefore, there is only BiF₃ which is stable. Contrary to Bi, as Sb is in the fifth period it doesn't contain f,d-orbitals with higher energy than s-valence sublevel. So all five electrons are available to form SbF₅. This is called the inert pair effect, when completed sublevels ($4f^{14} 5d^{10}$ for Bi), especially for elements from the down periods, interact with valence orbital (5s for Bi) decreasing its energy. This makes it more inert towards interaction with valence orbital of another element (this case F).