ABSTRACT

A series of molecular, chemical transformations, involving antimony (Sb), chlorine (Cl), and fluorine (F) is described. Chemical methods for synthesizing Sb-Cl bonds in thermally stable, small molecules are well-known, however, not well known for molecules which are stable to chemical attack by air (oxygen and water). Using an air-stable Sb-Cl chemical compound developed by my host institution, a novel route into the synthesis of the much more rare, Sb-F chemical bond has been developed. The new compound has been thoroughly characterized by standard, molecular methods (multi-nuclear NMR, variable-temperature NMR, IR, Mass spectroscopy, and single-crystal X-ray diffractionmetry), and in addition, is shown to be stable to oxygen and water, highly unusual (perhaps unique) for a chemical compound which contains two fluorine bonds to antimony (Rat, et al).

Making the Sb – F bond, : “Hip”SbF₂

Due to the remarkable stability of “Hip”SbCl₂, an attempt was made to synthesize “Hip”SbF₂ using transformations of the known, fluorinating agent, Bu₃SnF, tributyl tin fluoride (Krause). Before much more detailed characterization had been completed, the presumed success of the reaction was observed qualitatively through the rapid dissolution of Bu₃SnF in the reaction solvent (Bu₃SnF is completely insoluble before it reacts), the detection of the characteristic (and toxic) odor of Bu₃SnCl, tributyl tin chloride, and the isolation, after filtration and distillation of solvent, of a stable, white solid, the putative product, “Hip”SbF₂.

VT - NMR

Mass spectrum analysis confirms the presence of a stable ion, C₆H₅NSbF⁺.

Fluorine detection at room temperature, showing averaging of the two, different geometrical forms to one signal response. The poor resolution of the spectrum is due to the averaging effect at relatively high thermal energy.

Further Work

The synthesis of this compound is being reproduced here at GVSU, and studies on its chemical reactivity will be pursued. Again, given the rarity of compounds containing stable, Sb – F bonds, much work can be achieved in elaborating a novel area of basic, chemical understanding of reactivity.

References