Rearrangement of TMS of Halogenated 1-Phenylethanone and Related Compounds in EI Mass Spectra

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Purpose

- Extend a comprehensive, high quality NIST/NIH/EPA EI mass spectral library by adding and examining more spectra of small molecules and the corresponding retention indices on GC-MS.
- As part of our quality control of the data, interpret the results based on expert knowledge of fragmentation patterns and with the help of our software MS Interpreter. Decide if there are reasonable explanations for the discrepancies. Improve MS Interpreter by feeding the new data into its algorithm.
- Specifically, explore the structural requirements for the loss of a chloromethyl radical from 2-Chloro-1-phenylethanone, TMS.

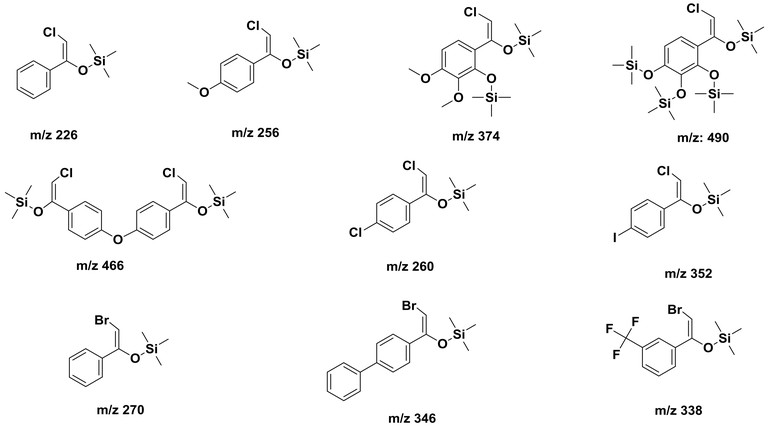
Introduction

While extending a comprehensive EI library of small molecules, we noted some unexpected peaks in certain silylated compounds, 2-Chloro-1-phenylethanone, TMS and related compounds. To assure that these peaks come from the fragmentation of the target compound rather than a contaminant or incorrect structures, we explored their origin and believe they arise from an unusual rearrangement mediated by a two hydrogen transfer. The first H-transfer originates from the TMS group and the second H-transfer renders an aromatic ring, followed by the loss of a chloromethyl radical. Evidence for the process leading to the unexplained peak is described in this work. An alternative pathway that is also consistent with the observations is depicted too.

Materials and Methods

Commercially available compounds were dissolved in acetonitrile at concentrations of 3mg/ml as stock solutions. TMS derivatives were prepared by adding BSTFA with 1%TMCS to stock solutions with the ratio 1:1 at 60°C for 1-2 hours. EI mass spectra were measured on GC-MS on a quadrupole mass spectrometer equipped with a 15m, 0.25mm i.d., 0.25μm film thickness low polarity GC column.

The examined compounds are listed below together with the molecular peak m/z values.



Results

1. The TMS derivatization of 2-Chloro-1-phenylethanone (**C1**) gives on GC-MS a molecular ion at m/z 226 and fragments at m/z 211,190, 155, 93 and 73 corresponding to $[M\text{-}CH_3\cdot]^+$, $[M\text{-}HCl]^{+\cdot}$, $[M\text{-}CH_2{=}SiCH_3CH_2\cdot]^+$ $(CH_3)_2SiCl^+$, $(CH_3)_3Si^+$, respectively. It also shows an unexpected important peak at m/z 177, corresponding to loss of 49 Da.

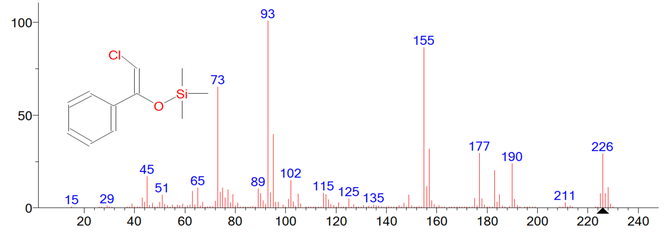


Fig. 1 EI spectrum of 2-Chloro-1-phenylethanone, TMS

2. MS Interpreter is used to interpret all the fragment ions in the spectrum.

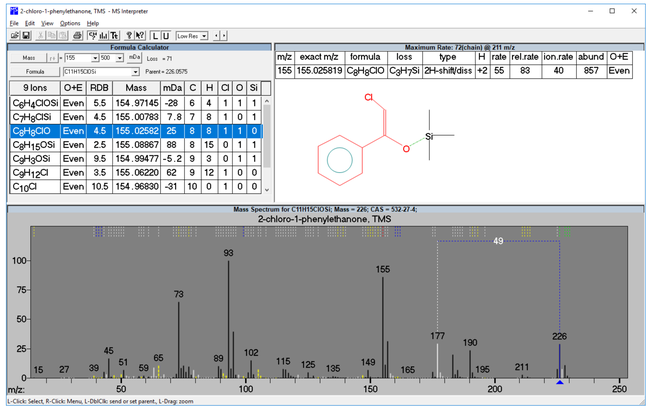


Fig. 2 MS Interpreter result of 2-Chloro-1-phenylethanone, TMS (**C1**)

All black peaks can be explained by MS interpreter and correspond to the structure marked in red on the top right window, the peak at m/z 155 is a loss of C_3H_7Si radical as shown in Fig. 2. The white peak at m/z 177 is not interpreted by the software, and it has a 49 Da difference from the molecular ion.

3. Hybrid Similarity Search (HSS) helps in the identification of the unknown peak at m/z 177.

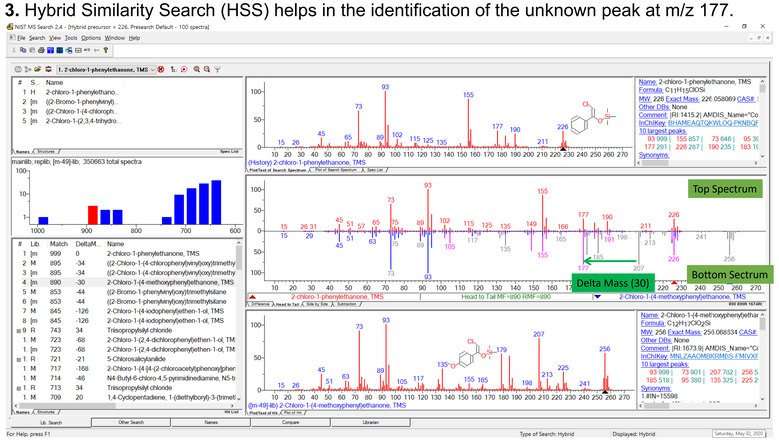


Fig. 3 Comparison of the TMS derivatives of 2-Chloro-1-phenylethanone (**C1**) and 2-Chloro-1-(4-methoxyphenyl)ethanone (**C2**) using Hybrid Similarity Search

HSS identifies compounds that differ from library compounds by a single "inert" structural component. Search of **C1** against NIST EI library finds a compound **C2** with a very high score 890, which has a mass difference of 30 Da (Delta Mass) compared with compound **C1** as shown in Fig. 3. The unknown peak at m/z 177 (top spectrum) perfectly matches the shifted peak at m/z 207 (marked with pink color, bottom spectrum).

4. A comparison of spectra of representative compounds.

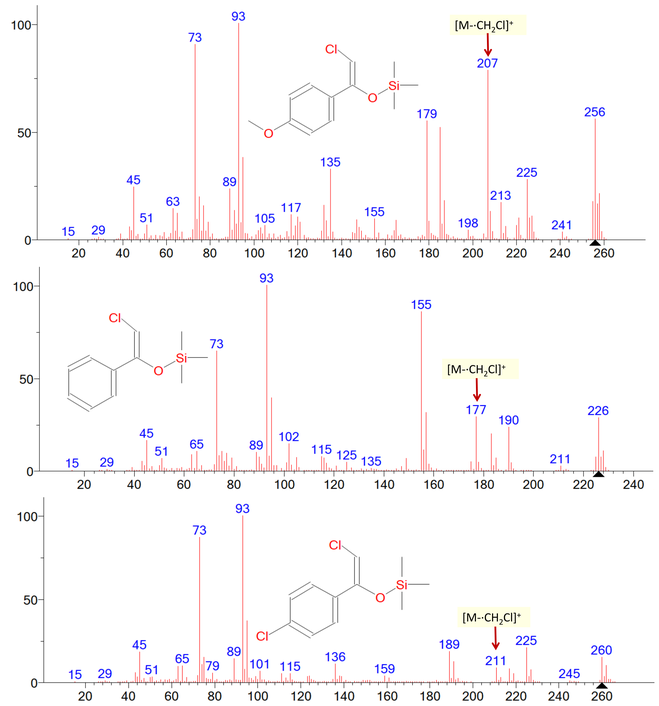
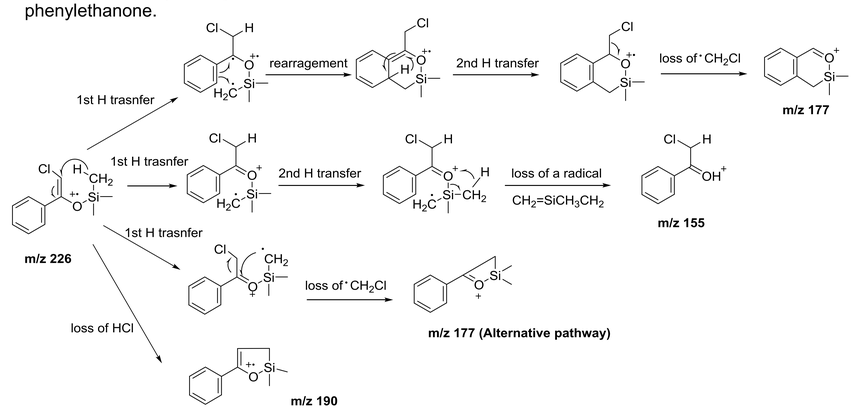


Fig. 4 EI spectra of TMS derivatives of 2-Chloro-1-(4-methoxyphenyl)ethanone, 2-Chloro-1-phenylethanone and 2-Chlomo-1-(4-chlorophenyl)ethanone

5. Fragmentation pathways, consistent with the observations, for the TMS derivative of 2-Chloro-1-phenylethanone.



Conclusions

The unusual loss of a chloromethyl or a bromomethyl radical from the TMS derivatives of halogenated 1-phenylethanones has been studied using the NIST developed MS interpreter and Hybrid Similarity Search software. The software provided help for our interpretation of a mechanism involving a double H-transfer for the release of a radical X-CH_2. There is also an alternative pathway consistent with the observations, which underlines the complexity of the process.