Thermal Activation of Togni's Reagent Generates $F_3C^{\bullet}$!

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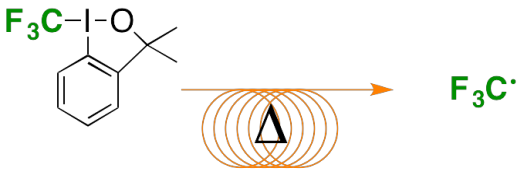
Since the original conception of Togni's reagents, they have become central to a plethora of trifluoromethylation strategies.[1] However, in stark contrast to the number of manuscripts published on their applications, dedicated mechanistic studies have been realized to a lesser extent. Nevertheless, a common feature found in most recent mechanistic schemes is the generation of an intermittent electrophilic trifluoromethyl radical ($F_3C^{\bullet}$) by action of a specific chemical activator. In this regard, especially metals (e.g. Cu salts, photoredox catalysts) as well as electron-rich organic materials (e.g. arenes, organic anions) are popular choices since these can potentially accomplish a single-electron reduction of the reagents. Most recently, we corroborated this elementary reduction step by means of pulse radiolysis and by relying on the solvated electron.[2] The present contribution showcases that simple thermal activation of Togni's reagent also furnishes $F_3C^{\bullet}$!



The thermal activation of Togni's reagent was explored in standard GC-MS equipment by means of gas phase trapping of the generated radicals with TEMPO.[3] To this end, a 1:5 mixture of Togni's reagent and TEMPO was studied by varying the temperature of the injection port - the latter serving as the reaction vessel. In these experiments, the abundance of TEMPO-CF_3 was shown to grow non-linearly with increasing temperature and a maximum efficiency of radical production was observed around 220 °C. Concomitantly, the release of methyl radicals ($H_3C^{\bullet}$) from the backbone occurred. Both events could also be identified by thermogravimetric analysis in conjunction with mass spectrometry (TGA-MS) of native reagent samples. In this contribution we will detail the experimental setup, acquired data and their mechanistic interpretation. Additionally, we will outline our attempts towards replication of these conditions in a laboratory scale setup to achieve additive-free radical trifluoromethylations with Togni's reagent.[4]

[1] Julie Charpentier, Natalia Früh, Antonio Togni, *Chem. Rev.*, **2015**, 115, 650-682.
[2] Nico Santschi, Thomas Nauser, *J. Fluorine Chem.* **2017**, *accepted.*
[3] Nico Santschi, Benson J. Jelier, Thomas Nauser, *submitted*.
[4] Nico Santschi, Benson J. Jelier, *submitted*.