New synthetic strategy for organic radicals as molecular qubits

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Abstract: with the aim to consider the advancing role of controlling chemistry from quantum information science applications, here we report unconventional synthesis of versatile mixed halide trityl radicals, opening a new frontier in the development of multifunctional organic radicals for quantum technologies.

In the last few years organic radicals play an important role in quantum science and technology, especially in the field of quantum materials. Thanks to their structure having an unpaired electron, radicals exhibit unique properties that can be tapped in quantum science. Several studies were carried out on the spin of the unpaired electron in organic radicals due to their ability to be use qubits. In fact, these molecules have a potential for easier integration with existing materials and systems [1]. Moreover, organic radicals find applications in several field for quantum applications, such as quantum materials, magnetic field sensing and entanglement [2]. The last one is another emerging field for radicals because there are able to be used for creating entangled quantum states which is a crucial resource for quantum communications [3].

Understanding how organic radicals participate in chemical reactions is important for development of quantum chemistry simulations. Following this way, we developed a new synthetic strategy for the preparation of a stable mixed halide polyfluorinated derivatives as promising radical system in quantum science. These radicals show a high reactivity in nucleophilic aromatic substitution and are perfect building for the synthesis of multifunctional organic materials. The developed new radical system, as polyhalogenated trityl radicals, has a particular advantage linked to the possibility to tune the electro-optical properties, which we have recently investigated just for inert trytil radicals via polyfluorination [4]. This approach holds promise to considerably simplify the synthesis of functionalized inert radicals which usually finds several limits such as high instability and low reactivity, can find application in several field, including quantum technologies as new molecular q-bits.

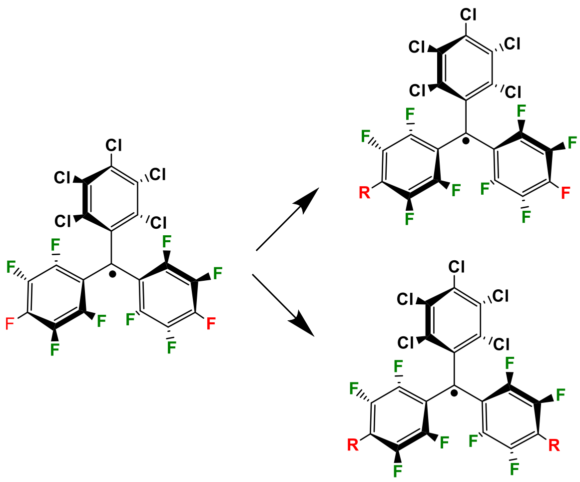

Fig. 1 Schematic representation of polyfluorinated systems in nucleophilic aromatic substitution for polyhalogenated trityl radicals

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