Stereoelectronic control of π-nucleophilicity

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Nucleophilicity is a ubiquitous concept in chemistry. According to IUPAC, nucleophilicity may be defined as the kinetic affinity of a Lewis base towards a common substrate, mainly involving the formation of a bond with a carbon atom. Whereas the electrophilicity is a well-defined concept, the achievement of a universal nucleophilicity model within the so-called conceptual density theory remains elusive.[1] Distortion-interaction analysis for the reaction of π-nucleophiles shown in Figure 1, reveals that the nucleophile-distortion energy smoothly varies from 1.6 to 2.4 kcal/mol across the studied series.[2] We herein present an alternative approach to measure this interaction energy, based on the Second Order Perturbation Theory Energies of interaction within the Natural Bond Orbital (NBO) framework, highlighting their stereoelectronic nature into a quantitative fashion. First, we estimate the electron-donor releasing ability of alkyl groups towards the electron-rich π-bond in both the TS region and reactants stage by computing the corresponding $\sigma_{C-H} \longrightarrow \pi^*_{C-C}$ and $\sigma_{C-C} \longrightarrow \pi^*_{C-C}$ stabilizing interactions. Thus, and in analogy with the distortion-interaction model, the difference between the corresponding $\Delta E^{(2)}$ of TS structure and reactants leads to the stabilizing interaction energy.
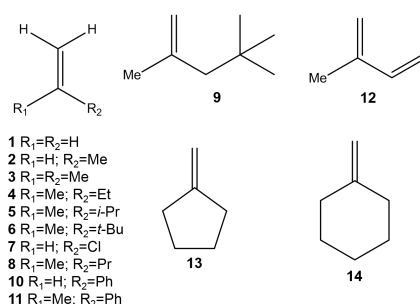

Figure 1: Structure of different π-nucleophiles analyzed.

References
1. P. K. Chattaraj; U. Sarkar, D. R. Roy, *Chem. Rev.* **106** (2006), 2065.
2. H. Mayr, B. Kempf, A. R. Ofial, *Acc. Chem. Res.* **36** (2003), 66.