Reliable DFT for Molecule–Environment Interaction

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Intermolecular interaction is ubiquitous in chemistry. It plays a major role in, for instance, the binding of drug molecules to enzymes. Thus, accurate determination of intermolecular interaction would be desirable, if not essential, for much of chemical research. In the present study, we have examined numerous DFT methods for calculating the interaction energy between a small molecule and its environment. These cover, notably, systems of solute-in-solvent and drug-in-enzyme, totaling over 200 interaction energies. Our results demonstrate the different requirements between simple systems such as a neutral solute in a neutral solvent and more difficult cases with part(s) of the system being charged. The extensive search reveals methods for accurate and low-cost computation of a wide range of interaction energies, which may facilitate rational drug design.

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