



## Solvation Effects in Organic Chemistry –

### from Reichardt's Dye to Solvent Control of Quantum Tunneling

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H46

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The importance of solvents and solvation processes in synthetic applications has been recognized since the early days of organic chemistry, and often the selection of the “right” solvent determines success or failure in synthesis.<sup>1</sup> Yet, in many cases solvent selection is based on empirical observations rather than on a rational physical basis. One of the most widely used empirical indicators for solvent polarity is the ET(30) scale introduced by Reichardt et al. In the first part of the lecture it will be discussed whether ET(30) and related scales reflect global solvent properties (macrosolvation) or rather local solvent effects (microsolvation) such as hydrogen bonding.<sup>2</sup> To answer this question we studied the cryosolvation of a modified Reichardt's dye (Figure). The key to controlling product selectivity by solvation is understanding how solvents affect reactive intermediates and transition states in chemical reactions. In the second part of the lecture, we will present a case study evidencing how subtle changes in a solvent mixture result in drastic changes in product selectivity of carbene reactions.<sup>3</sup> Reactions of carbenes in solvent mixtures were studied by ultrafast and low-temperature spectroscopy in combination with explicit solvent models (QM/MM simulations). Quantum mechanical tunneling (QMT) provides an alternative pathway for chemical reactions that bypasses the transition state and thus negates the guidelines for thermal reactions deduced from discussing properties of transition states. Nevertheless, tunneling reactions show large solvent effects, and understanding these effects requires thinking beyond traditional reaction coordinates and transition states. Qualitative concepts for solvent effects in tunneling reactions will be discussed in the third part of the lecture.<sup>4</sup>