

# Multidimensional IR Spectroscopy: Chemistry and Biophysics in Real Time

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Multidimensional IR spectroscopy uses vibrations to probe molecular structure and dynamics with femtosecond time resolution. Different types of multidimensional IR experiments have been implemented that reveal energy transfer,<sup>1</sup> couplings<sup>2,3</sup> and correlations<sup>4</sup> of vibrations, which are closely linked to molecular structure and its change in time.

The use of mixed IR/VIS pulse sequences further extends the potential of multidimensional IR spectroscopy, enabling studies of ultrafast light triggered processes,<sup>4</sup> subensemble-selective photochemistry<sup>5</sup> as well as surface specific,<sup>6</sup> highly sensitive experiments.

In my talk I will discuss the potential and the limitations of multidimensional IR spectroscopy, using examples from various fields from small molecules to proteins.

## References

- 1 H. M. Müller-Werkmeister, Y.-L. Li, E.-B. W. Lerch, D. Bigourd and J. Bredenbeck, *Angew. Chem. Int. Ed.*, 2013, **52**, 6214–6217.
- 2 A. T. Messmer, K. M. Lippert, S. Steinwand, E.-B. W. Lerch, K. Hof, D. Ley, D. Gerbig, H. Hausmann, P. R. Schreiner and J. Bredenbeck, *Chem. Eur. J.*, 2012, **18**, 14989–14995.
- 3 A. T. Messmer, K. M. Lippert, P. R. Schreiner and J. Bredenbeck, *Phys. Chem. Chem. Phys.*, 2013, **15**, 1509–1516.
- 4 J. Bredenbeck, J. Helbing, K. Nienhaus, G. U. Nienhaus and P. Hamm, *Proc. Natl. Acad. Sci.*, 2007, **104**, 14243–14248.
- 5 van Wilderen, Luuk J. G. W., A. T. Messmer and J. Bredenbeck, *Angew. Chem. Int. Ed.*, 2014, **53**, 2667–2672.
- 6 J. Bredenbeck, A. Ghosh, H.-K. Nienhuys and M. Bonn, *Acc. Chem. Res.*, 2009, **42**, 1332–1342.