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Introduction

Coherent control of photochemical and photobiological processes

Coherent control aims to steer a quantum mechanical system towards a desired outcome by exploiting interference effects. As the field has grown, so too have the variety and complexity of applications. This special issue of the *Journal of Photochemistry and Photobiology A: Chemistry* is devoted to applications of coherent control strategies to photochemical and photobiological processes.

The goal of this special issue is to give an overview of the present status and scope of research in this field. The 13 invited contributions illustrate the diversity of theoretical approaches and experimental applications, yet are, nonetheless, a small sampling of the current research activity.

Ho and Rabitz start off the issue by pondering over the apparent ease with which coherent control experiments succeed, offering new insight into the topology of quantum control landscapes relevant to simple as well as complex systems.

Diatomic molecules serve as prototype systems for many studies of coherent control. Strong field control is investigated theoretically by Chang et al. with the aim of squeezing the widths of vibrational wave packets in Na_2, as well as by Wollenhaupt and Baumert for switching population among target states in K_2. Both approaches may ultimately be extended to more complex systems. Alkali dimers are also the focus of the contribution from Lindinger et al., who review their recent work on controlling various model systems, which may turn out to be an important precursor to applications for creating molecular Bose–Einstein condensates. Alekseyev et al. simulate coherent control of wavepacket dynamics in near-degenerate singlet and triplet excited states of matrix-isolated Cl_2, leading to preparation of a pure spin state in a specific time and bond length window.

A local control theory described by Gräfe et al. connects quantum and classical dynamics in simple prototype systems, which may also find application to complex (bio)molecular systems.

Cardoza et al. study molecular fragmentation mechanisms in a halogenated acetone, one of a family of substituted acetones from which they aspire to determine systematic control mechanisms.

The contribution by Geppert and de Vivie-Riedle explores control of the ring opening and closure in cyclohexadiene, central to the mechanism of fulgide molecular switches that may find applications in photonic devices and molecular computation.

Konradi et al. explore discrimination of specific molecular signals from liquid mixtures, which may eventually find applications in microscopy. In a similar vein, Courvoisier et al. present experiments in support of a novel method for discrimination between airborne bacteria and organic aerosols using multi-pulse sequences. The application to microscopy is further examined by Dela Cruz et al., who show how coherent control can be used to improve biomedical imaging as well as to reduce photodamage in tissue.

At the end of the complexity spectrum, Buckup et al. show how coherent control can be utilized as a powerful spectroscopic tool for disentangling complex transient absorption spectra of biomolecules, demonstrated by application to the control of β-carotene deactivation pathways. The relevance to photosynthetic function is expanded by Brüggemann et al. who investigate control of exciton dynamics in the Fenna–Matthews–Olsen pigment-protein complex using polarization-shaped pulses.

Finally, I would like to thank all of the contributors and referees for their efforts in preparing and polishing the high quality papers of this issue. I am very grateful to Monique Martin and the JPPA editorial office for the efficient and friendly help with all organizational details. I sincerely hope that this special issue will play an informative, as well as an inspirational, role for the readers of the journal.

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