GAS PHASE REACTION DYNAMICS AND DESIGN OF MOLECULAR CLUSTERS AND BIOCONJUGATES

Thesis by

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In Partial Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, California

2005

(Defended May 12, 2005)

Acknowledgements

Many people have contributed to the work contained in this thesis and have helped me through my educational career. I would like to thank my friends who have mentored me in chemistry, particularly Steve Orensky, who initially piqued my interest in the subject; Jay Thoman, who was the best undergraduate advisor I could have possibly had; and Don McQuarrie, who taught me a great deal about physical chemistry and was generous enough to offer me authorship on a solution manual to accompany his book.

My advisor, Jack Beauchamp, has been a huge influence on my scientific development. He has been an inexhaustible source of ideas and inspiration, and it has been a privilege to work with him. I also thank all of the Beauchamp group members I have worked with through the years: Dmitri Kossakovski, Sang-Won Lee, Jim Smith, Daniel Austin, Ron Grimm, Rob Hodyss, Ryan Julian, and Hugh Kim. I've enjoyed getting to know these intelligent and interesting people.

Mike Anchondo, Don Skelton, and Tom Dunn were great resources when I was wrestling with thorny electronics problems, and I appreciate the help of Mike Roy and Guy Duremberg in the machine shop. Patrick Piccione, in the Mark Davis lab, and Jeremy May, in the Brian Stolz lab, both provided materials used in experiments detailed in this thesis. I'd also like to thank Aron Kuppermann for his friendship and encouragement during my time here, which has meant a lot to me.

Much of the work presented in this thesis was done in collaboration with other students. I would like to thank Ryan Julian and Sang-Won Lee for their contributions to the work on sodiated glycine oligomers. Rob Hodyss merits special thanks for a prolonged and very productive collaboration, which has resulted in several publications

on cluster-phase chemistry and free-radical initated peptide squencing, also presented in this thesis. It has been extremely rewarding to work with him.

I am also grateful to those who have contributed financially to my graduate work, particularly the Beckman Institute and the National Science Foundation. An NSF Graduate Research Fellowship aided me personally during my time here.

Finally, I would like to thank the many friends and family members who have helped me throughout my time at Caltech. My parents, brother, and sister have been wonderful throughout, encouraging me to do my best and always providing unstinting love and generosity. In particular, I would like to thank my husband, Matthew Sumner, who has been an unwavering source of confidence and support throughout my degree work, and without whom I never could have accomplished everything that I have.

Abstract

Chapter 1 serves as an introduction to the design of molecular clusters and bioconjugates that exhibit interesting reactivity in the gas phase. In Chapter 2, gas-phase reactions of clusters of alkylammonium ions with triphosphate, DNA, and peptides are examined. Alkylation of both phosphate and carboxylate groups is observed. In Chapter 3, the gas phase reactions of methyl phosphate noncovalently bound clusters are studied in detail. The presence of sodium ions in methyl phosphate clusters stabilizes the clusters, facilitating intermolecular condensation reactions between methyl phosphates.

In Chapter 4, the first gas-phase phosphorylation of molecules containing hydroxyl substituents is reported. Gas-phase reactions of triphosphate with hydroxyl-containing molecules result in phosphorylation of the hydroxyl substituent. In the absence of a hydroxyl substituent, the C-terminus of a peptide can be phosphorylated. Otherwise, hydroxyl residues are selectively phosphorylated.

Chapter 5 considers the possibility of free radical initiated peptide sequencing, or FRIPS, in the gas phase. A free radical initiator is conjugated to the N-terminus of peptides or proteins, forming a bioconjugate. Collision-induced dissociation of the conjugated species results in free radical formation. The free radical then fragments on further collisional activation to yield backbone fragmentation products. This technique may allow selective cleavage of peptides at specific amino acid residues, with applications to gas-phase proteomics sequencing efforts.

Chapters 6 deals with experiments conducted on solvated ions, specifically focusing on the evaporation kinetics and the relative intensities of differently solvated species. Water cluster distributions are used to discriminate between isomers and

enantiomers. Chapter 6 also includes data on the reaction of *t*-butyl chloride in water clusters, as well as data on doubly charged cationic species showing pairwise evaporation of water.

Chapter 7 uses H/D exchange experiments to examine the behavior of sodiated glycine oligomers, ranging from Gly_1 to Gly_5. It is found that H/D exchange dynamics do not directly reflect the structure of sodiated glycine oligomers, as the solvation energy provided by the exchange reagent can allow the ion-molecule complex to access high-energy states. Therefore, interpretations of H/D exchange results should be conducted with detailed examinations of possible exchange mechanisms.

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