Ben-Gurion University of the Negev
אוניברסיטת בן-גוריון בנגב

Graduate Students Seminar

Department of Chemistry

Sunday, June 20th, 2023

Time 14:00

Bldg. 43 Room 015

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Under the supervision of Prof. Ehud Pines

Stability of Carbonic Acid in Solution and Kinetics of its Chemical Processes

Carbonic acid (CA) is an important compound present in various natural systems, but its rapid breakdown into H2O and CO2 has impeded its examination. Scientists have faced challenges in isolating and characterizing CA due to its instability in the presence of water and acids. However, recent advancements in experimental methods have opened up new avenues for exploring this elusive molecule. These investigations have revealed that water and protons act as primary catalysts for the decomposition of CA. Given these observations, it is reasonable to propose that CA might exhibit enhanced stability when immersed in non-aqueous environments.

To investigate the kinetics of intact CA in alcohol solutions and mixtures with aprotic solvents, I employed an advanced stopped-flow setup in this study. The results indicate that CA demonstrates greater stability in these solutions compared to water, presenting new possibilities for studying this compound. I examined two distinct processes—dissociation into water and CO2 and proton transfer from CA to a base. By determining the pKa of CA as a function of temperature and assessing the lifetime of CA in alcohol solutions and mixtures with various aprotic solvents, I successfully modeled the protonation reaction of Brønsted bases by CA in alcohol solvents.

This analysis showcased that the enhanced stability of CA in a medium lacking protons drives efficient protonation of mild bases.

My study presents promising opportunities for further investigations into intact CA in non-aqueous environments. By identifying experimental conditions that facilitate the presence of long-lived CA in solutions, we can explore its spectroscopic properties and chemistry using steady-state techniques. It is highly probable that long-lived intact CA can be found in hydrophobic biological settings, and it is crucial not to overlook the reactivity of intact CA in biological systems.