

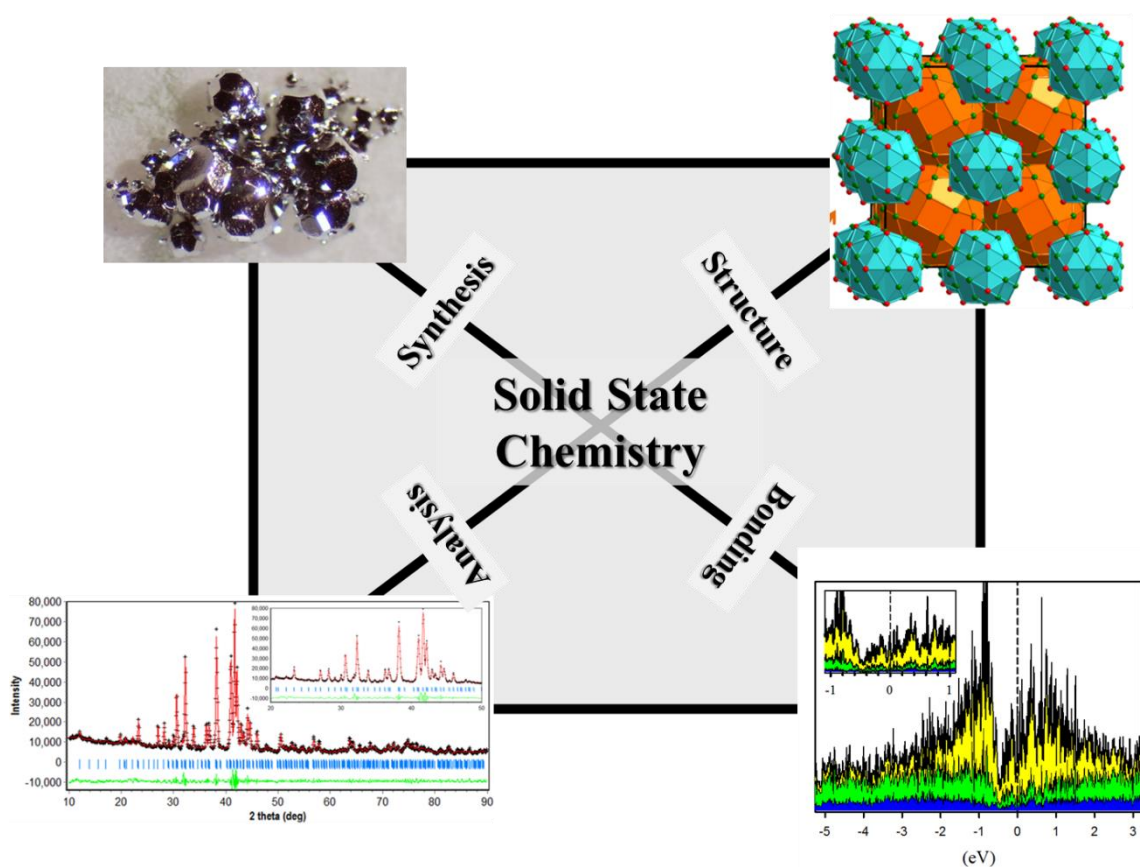
Solid State Chemistry

(Notes to accompany the lectures in CHEM 571)

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Images are from the doctoral research of Weiwei Xie in Prof. Gordon J. Miller's group.

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PREFACE

Solid State Chemistry (CHEM 571) is an inter-disciplinary course at Iowa State University conceived and offered by Chemistry professors John D. Corbett, Robert E. McCarley, and H. Fritz Franzen, who have been three influential solid-state chemists in the United States and played a significant role for the growth of solid-state chemistry in the United States since the 1960's. Their scholarly backgrounds identify the breadth of this discipline: John Corbett was an expert in molten-salt chemistry and discovered hundreds of compounds involving nearly all elements in the periodic table; Robert McCarley was an expert in cluster chemistry of transition metals and he developed numerous synthetic strategies to prepare reduced transition metal compounds showing novel bonding modes and interesting chemical and physical properties; and Fritz Franzen was an expert in high-temperature chemistry and furthered the notion of Landau theory to assess solid-solid phase transitions and discovered numerous metal-rich compounds available only by high-temperature synthetic methods.



John Corbett[†]



H. Fritz Franzen



Bob McCarley[†]

These three chemists fostered friendships and collaborations with scientists worldwide, interactions that placed Iowa State University and the Ames Laboratory on the map as an influential center of solid-state research. They hosted numerous visiting scientists and post-doctoral fellows to their research groups, as well as mentored many graduate students who have gone on to become highly respected faculty and industrial scientists. And they helped to establish two important activities in the discipline: (1) the Gordon Research Conference in Solid State Chemistry, a biennial meeting that began in 1980 and has prospered into one of the most widely attended international conferences in the discipline; and (2) a National Science Foundation “summer school” to introduce faculty and students to solid state chemistry. To the best of my knowledge, this summer school no longer exists, but there are various NSF-REU (“Research Experiences for Undergraduates”) programs that offer some solid-state chemistry components.

Chemistry 571 began as a 3-credit course offered during alternate academic years and was co-taught by two instructors with several class periods set aside for guest lectures from scientists within the Iowa State University community as well as from other institutions. The course was originally designed to be an inter-disciplinary course within the Chemistry graduate curriculum. During this time, the course provided background in structural systematics, space group symmetry, nonstoichiometry, phase transitions, photoelectron spectroscopy, electronic bands, magnetism, and electrical properties before addressing specific topics such as metal oxides, intercalation, metal-rich compounds, Zintl phases and polar intermetallics, among others. This offering

continued until the mid-2000's, when the Inorganic Chemistry faculty at Iowa State University decided to modify the graduate curriculum. Chemistry 571 was then changed to a 2-credit course and became one of four sub-disciplinary courses offered for a graduate degree in Inorganic Chemistry (Organometallics, Kinetics, and Bioinorganic Chemistry being the other three offerings). At that time, Chemistry 571 would be taught by a single instructor, and it continued to be offered during alternating academic years. I had been part of the earlier 3-credit/2-instructor offering and then became the sole instructor of this course after the transition. Given the reduction in credit hours and thereby contact hours, the course evolved to emphasize structure, synthesis, characterization, and bonding. Discussions about physical properties were covered in other courses offered by the Departments of Materials Science or Physics and Astronomy. Also, a course in "Diffraction" (Chemistry 575), which was originated and taught by Professor Robert Jacobson, was removed from the catalog upon Prof. Jacobson's retirement. As a result, some diffraction basics were inserted into Chemistry 571. In 2018, Prof. Kirill Kovnir resurrected Chemistry 575, so it may be time to revise the content of Chemistry 571 going forward.

Gordon J. Miller
August, 2024

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