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| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Monday, July 1st, 2024 at 13:30**

**Room 4**

**Enhancing Magnesium-Metal Batteries Performance via Electrolyte Species Optimization**

**Dr. Ahiud Morag**

**Department Seminar**

Technische Universität Dresden, Dresden, Germany

Max Planck Institute of Microstructure Physics, Halle, Germany

Magnesium-metal batteries (MMBs) present a promising solution to the growing demand for advanced energy storage systems. However, challenges related to electrolyte compatibility and cathode electrochemistry significantly impede their practical application. Cl-containing electrolytes are particularly attractive due to their superior anode performance. Nonetheless, a critical challenge in the development of Cl-containing electrolytes is the high bonding energy between Mg and Cl ions, primarily caused by the prevalence of large MgxCly2x-y clusters (e.g., Mg2Cl3+ and Mg3Cl5+), which are the most stable species in the electrolyte. Prior studies have indicated the potential catalysis of Mg-Cl dissociation within the Mo6S8 cathode, though this phenomenon has not been successfully replicated in other systems.

This study addresses the suboptimal cathode electrochemistry associated with Cl-containing electrolytes by manipulating the electrolyte species. The incorporation of ionic liquid additives into conventional MMB electrolytes results in a notable enhancement of electrochemical performance. To elucidate the role of ionic liquids in this performance improvement, we first investigate the reactions occurring at the cathode through electrochemical, structural, and chemical characterization techniques. Subsequently, the interactions between the additives and electrochemically active species were studied using experimental methods and molecular dynamic simulations. Our findings challenge the conventional paradigm that material engineering is the sole parameter influencing MMBs electrochemistry, revealing instead a complex multistep reaction mechanism involving both reduction and oxidation processes at the cathode.