澳大利亚联邦科学与工业研究组织 (CSIRO)
Dr. Theo Rodopoulos特邀学术报告

时间：2010年12月1日（周三）上午9:30-11:00
地点：过程大厦**312** 会议室

Fundamental and Practical Aspects of Ionic Liquids

摘要/Abstract

The classical Hall-Héroult industrial process for aluminium production has several inherent disadvantages such as high capital and energy demands, and environmental issues associated with hazardous spent potliners and perfluorocarbon emissions (e.g. CF_4 and C_2F_6). Similarly, the two commercial processes for electroplating of aluminium, namely, the SIGAL and REAl processes have the disadvantage of employing flammable and volatile materials. Over the years, considerable research effort has been spent on developing alternatives to these aluminium electrodeposition processes to reduce the cost of the metal and make the process more green however, no commercially feasible and cost competitive processes have evolved to date.

A new class of molten salts called ionic liquids, which are salts that are molten at, or near, ambient temperature, have been widely investigated as electrolytes for electrochemical applications due to their wide electrochemical windows, high conductivities and their ability to dissolve a large range of metal salts. Aluminium electrodeposition has been demonstrated from “first generation” chloroaluminate ionic liquids and more recently from "second generation" water stable ionic liquids. An overview of these low temperature aluminium electrodeposition processes will be given and the benefits and challenges of these ionic liquid processes will be outlined. The aluminium chemistry in the two types of ionic liquids is significantly different due to the ionic liquid composition. Aluminium speciation studies conducted on bis(trifluoromethylsulfonyl)amide (NTf_2)-containing ionic liquids will be discussed. Raman spectroscopy, density functional theory calculations and variable temperature ^{27}Al NMR are used to identify the numerous aluminium-containing species in solution. Also, correlation of this data to electrodeposition results sheds light on the electroactive species responsible for aluminium metal in NTf_2-based ionic liquids. Understanding the coordination chemistry taking place in ionic liquids upon the addition of metal salts is important for understanding and improving processes such as metal electrodeposition.

The structure-property relationship in ionic liquids can be improved by knowledge of the solid state structure. This information in turn can assist the design of new ionic liquids and make the design process more rational. The single crystal structure of an NTf_2-based ionic liquid and its analogous bromide salt determined by X-ray diffraction will be discussed. A comparison of the ionic liquid structure with the analogous halide salt provides valuable information about the effect of anion size and charge distribution on the strength of the cation-anion interactions, the crystal packing of ions within the lattice, and the thermophysical properties of the ionic liquid. A synchrotron powder diffraction study of the crystallinity and phases of the NTf_2-based ionic liquid as a function of temperature will also be discussed.

Furthermore, an overview of the Commonwealth Scientific and Indistrial Research Organisation (CSIRO) and the capabilities of CSIRO Process Science and Engineering will also be presented.

报告人简介/Background

Dr Theo Rodopoulos is a chemist and PhD graduate of the University of Adelaide, who after postdoctoral work at the University of Victoria, Canada took up a position as a research scientist at CSIRO in 1997. His initial research focussed on mineral processing where he worked on a number of projects to improve the beneficiation (pre-treatments to improve yield) of ores for various Australian and overseas mining companies. His particular interest in flotation research was the design and synthesis of novel flotation collectors for imparting improved mineral selectivity during the processing of base metal sulphide ores.

Dr Theo Rodopoulos currently leads a team in the Solution Processing Group of CSIRO Process Science and Engineering which is interested in the chemistry and properties of ionic liquids and their application in metal production, in particular light metals such as aluminium. His team has established collaborations with numerous Universities and research institutions and maintain close links with prospective users in industry.