Spring 2016 Joint Colloquium
Materials Department & Materials Research Laboratory

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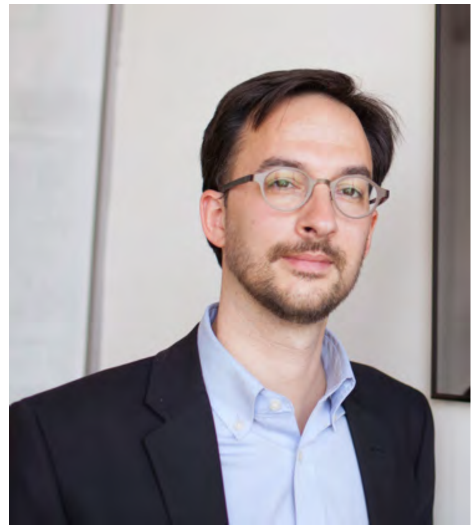

Friday, May 20th, 2016
11:00 am, ESB 1001

Electrochemistry in the Molten State: From Sustainable Metal Extraction to Materials Fundamentals

Metals and metallurgy played a foundational role in the materials science we learn today, in particular to demonstrate how condensed matter physics allows the prediction of solid-state properties. Similar predictive capacity is lacking for the molten state, and liquid metals and molten oxide or sulfide are again remarkable candidates to progress in that endeavor.

Independently of this conceptual lanscape, metals remain at the basis of modern society and their affordable and environmentally respectable extraction and recycling is required. In the context of 9 billion people by 2050 and issues such as greenhouse gas emissions, my research group aims at developing alternative approaches for metals extraction and processing. The electrochemistry of the molten state is an integral part of our endeavor, compatible with the deployment of sustainable electric power generation [1]. This seminar offers to report electrochemical studies of a subset of molten oxide [2,3] and sulfide [4] systems. Our results show that the molten state offers unique functionalities (enhanced mass transport, high conductivity, electronic conductivity, thermoelectric power) and that electrochemistry is uniquely positioned to probe the structure and physical chemistry of those systems. In addition, our results provide valuable thermodynamic information, and our experimental developments suggest a faster path to experimental data, along with an improvement in the prediction and modeling capacity of the molten state.

[1] A. Allanore, Contribution of Electricity to Materials Processing: Historical and Current Perspectives, JOM,65(2), 131, (2013)
[2] A. Allanore, Features and Challenges of Molten Oxide Electrolytes for Metal Extraction, Journal of the Electrochemical Society, 162(1), 13-22, (2015)
[3] A. Allanore, L. Yin & D. R. Sadoway, A New Anode Material for Oxygen Evolution in Molten Oxide Electrolysis. Nature, 497(7449), 353–356, (2013)
[4] S. Sokhanvaran, S.-K. Lee, G. Lambotte & A. Allanore, Electrochemistry of Molten Sulfides: Copper Extraction from BaS-Cu2S. Journal of The Electrochemical Society, 163(3), 115–120, (2016)

Bio Prof. Allanore's research applies to sustainable materials extraction and manufacturing processes. He joined MIT in 2010, after several years of service within one of the world largest iron and steel R&D center. As a faculty in the Department of Materials Science & Engineering, he has developed numerous alternative approaches to metals and minerals extraction and processing, for example a waste-free process to produce a potassium fertilizer from earth-abundant raw materials. In the field of metal extraction, he demonstrated a new electrolyte for metal extraction from sulfides, which offers to produce copper, molybdenum, tin, zinc or precious metals without SOx emissions. With an emphasis on electrochemical methods for both analytical and processing purposes, the Allanore group offers a unique combination of experimental and modeling approaches to promptly investigate the ultimate state of condensed matter, the molten state, and its relation with the corresponding solid-state phases. Prof. Allanore was awarded the TMS DeNora Prize in 2012, recognizing outstanding contribution to the reduction of environmental impacts, especially focused on extractive processing, as well as the Early Career Faculty award also from TMS.

http://allanore.mit.edu Hosted by Anton Van der Ven