Materials Science & Engineering and Metallurgical Engineering Graduate Seminar

Wednesday, March 20 2019, 4:10-5:00PM, FASB 295

Rahul Sarkar, PhD candidate METE

Interactions if iron/iron oxide and slags with pure Al2O3 refractory under flash ironmaking conditions

A novel flash ironmaking technology (FIT), based on the direct reduction of iron ore concentrate with a reductant gas such as hydrogen, natural gas, coal gas, or a combination thereof in a flash furnace, has been developed at the University of Utah. In the development of FIT and its proposed scale-up in the near future, the choice and design of refractories is expected to play a pivotal role. In this work, interactions of iron/iron oxides and slags with pure Al2O3 refractory have been studied in the temperature range 1100°- 1500°C under H2/CO/CO2/H2O environments relevant to FIT. Thermodynamic basis for the interaction of iron/iron oxides and slags with pure Al2O3 has been developed by considering the Fe-Al-O system and a solid-state diffusion based kinetic model has been proposed to describe the growth of the hercynite (FeAl2O4) spinel formed as a result of the interaction. Reacted samples from Al2O3-iron/iron oxide/slag experiments were analyzed using XRD, SEM-EDX and EPMA techniques and the analyses showed that the proposed models suitably describes the growth of the interaction product layers, which obeyed the parabolic rate law at all temperatures.

David Magginetti, PhD candidate MSE

Solvent-based delaminatin of polycrystalline CdS/CdTe thin-films through interface engineering

Recent progress in CdTe research has extended usage of this thin film photovoltaic material to use on flexible substrates such as plastic, cellulous papers, and fabric, but devices based on those platforms generally achieve their highest efficiencies around 10-15%, much lower than seen for the record device (22.1%). A significant factor in this reduced efficiency is the need for high-temperature processing (> 450 °C) to recrystallize grains. Here I discuss a new synthesis method to create freestanding CdS/CdTe films by combining high-temperature deposition of CdS/CdTe films on Si/SiO_2 substrates and a simple lift-off process in a water environment at room temperature. Delamination is facilitated by the presence of a Te-rich layer that is approximately 20 nm thick at the SiO_2/CdS interface and potentially also due to the innate lattice mismatch of the substrate and film. High-resolution electron microscopy and spectroscopy measurements confirm that the CdS/CdTe film is physically liberated from the substrate without leaving any residue, while preserving their initial structural and compositional properties.