Seminário do Dr. Isnaldi R. Souza Filho no DEMAR – EEL-USP

O Dr. Isnaldi Rodrigues de Souza Filho se formou em Engenharia de Materiais pela Escola de Engenharia de Lorena (EEL-USP) em 2013, tendo recebido o prêmio de melhor aluno da sua turma. Defendeu a sua Dissertação de Mestrado em 2015 e a sua Tese de Doutorado em 2019 pelo Programa de Pós-Graduação em Engenharia de Materiais (PPGEM) da EEL-USP. Pelo seu Doutorado, recebeu o Prêmio Capes de Tese 2020 – na área de Engenharias II. No período 2020-2021 fez pós-Doutorado no Max-Planck Institut für Eisenforschung (MPIE), em Dusseldorf – Alemanha. Desde 2022 é líder do grupo "Sustainable Synthesis of Materials" do MPIE. Atualmente também é docente na "Université de Lorraine", em Nancy, França, na área de "Sustainable Metallurgy". No próximo dia 28/02 o Dr. Souza Filho apresentará um seminário no DEMAR (auditório principal), com início às 14 h, intitulado "Sustainable steel through hydrogen plasma reduction of iron ores".

Sustainable steel through hydrogen plasma reduction of iron ores

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Abstract

Steel is the backbone of modern society. Although it is a key enabler of sustainability, its primary synthesis route is a heavy CO2 emitter. With about 2.1 tons of CO2 emitted per ton of produced steel, the ironmaking sector alone is responsible for ~8% of all CO2 emissions on the planet. This is because the current technologies to extract iron from its ores use carbon-carrier substances as reducing agents, a fact that leads to CO2 as the by-product. To fight global warming, the most polluting sources must be tackled, especially the steel manufacturing sector.

Reducing iron ores with hydrogen may offer an attractive alternative to producing iron sustainably. Amongst the opportunities, hydrogen-based direct reduction of iron ores is a sustainable route to producing iron at an industrial level. In this process, solid iron ores are reduced by being directly exposed to gaseous hydrogen at temperatures ranging from 800-1000°C. Water is the by-product of the process rather than CO2. The obtained directly reduced iron (DRI), as a solid material, has to be subsequently melted in an electric arc furnace (EAF) together with steel scraps to produce liquid steel in a two-step process.

The possibility of shortcutting the DRI-EAF route emerges with the exploitation of hydrogen plasma species (H, H+) that can be created in EAF filled with small fractions of H_2. In this route, a lean hydrogen thermal plasma is ignited between the electrode of an electric arc furnace (EAF), slightly modified to support small partial pressures of hydrogen (e.g., 10% H2), and the ore to be processed. During the process, both melting and reduction occurs simultaneously. This means that liquid iron is produced in a single step from its ores.

In this lecture, the fundamental aspects of the hydrogen direct reduction (DR) and hydrogen plasma smelting reduction (HPSR) will be presented and discussed, with a focus on the chemical evolution and phase transformations of the processed ores.