MM 18: Topical Talk: Dierk Raabe

Time: Tuesday 9:30–10:00 Location: C 130

Topical Talk MM 18.1 Tue 9:30 C 130

Transport and phase transformations in sustainable hydrogen-based steel production — •Dierk Raabe, Yan Ma, Isnaldi Souza Filho, and Özge Özgün — Max-Planck-Institut für Eisenforschung, Max-Planck-Str. 1, 40237 Düsseldorf, Germany

Steelmaking causes 8% of all global greenhouse gas emissions, qualifying it as biggest single cause of global warming, due to the use of fossil carbon as reductant [1,2]. Mitigation strategies pursue the replacement of fossil carbon carriers by sustainably produced hydrogen and / or electrons. We presents progress in understanding the mechanisms of hydrogen-based direct reduction and plasma reduction of iron oxides and explain how metallization and kinetics depend on mass transport kinetics, nucleation and growth phenomena, chemical and stress partitioning, oxide chemistry and microstructure, porosity, plasticity, damage and fracture effects associated with the phase transformation phenomena occurring during reduction [3,4].

1. Raabe, D., Tasan, C. C. & Olivetti, E. A. Strategies for improving the sustainability of structural metals. Nature 575, 64-74 (2019).

2. Raabe, D. The Materials Science behind Sustainable Metals and Alloys. Chem. Rev. 123, 2436-2608 (2023).

3. Kim, S. H. et al. Influence of microstructure and atomic-scale chemistry on the direct reduction of iron ore with hydrogen at 700°C. Acta Mater. 212, 116933 (2021).

4. Souza Filho, I. R. et al. Green steel at its crossroads: Hybrid hydrogen-based reduction of iron ores. J. Clean. Prod. 340, 130805 (2022).