Sustainable steel through hydrogen plasma smelting reduction of iron ores

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Sustainable steel *Hydrogen plasma* *Sustainable metallurgy*

Steel is the backbone of the modern society. Although it is a key enabler of sustainability when used in efficient devices for energy conversion (or through its high recyclability rates), its primary synthesis route is a heavy CO_2 emitter. With about 2.1 tons of CO_2 emitted per each ton of produced steel, ironmaking sector alone is responsible for ~8% of all CO_2 emission on the planet [1]. This is because the current technologies adopted to extract iron from its ores use carbon-carrier substances as a reducing agent, a fact that leads CO_2 as the by-product. To fight global warming, the most polluting sources must be tackled, especially the steel manufacturing sector.

Reduction of iron ores with hydrogen plasma species (H, H^+) may offer an attractive alternative to produce iron sustainably. In this route, a lean hydrogen plasma is ignited between the electrode of an electric arc furnace, slightly modified to support small partial pressures of hydrogen (e.g., 10%H_2), Fig. 1(a), and the ore to be processed [2]. During the process, both melting and reduction occurs simultaneously, as shown in Fig. 1(b). This means that liquid iron is produced in one single step from its ores, with water being the by-product rather than CO_2 [2,3]. In this talk, the fundamental aspects of the emerging hydrogen plasma smelting reduction (HPSR) technique will be presented and discussed, with focus on the chemical evolution and phase transformations of the processed ores [4].

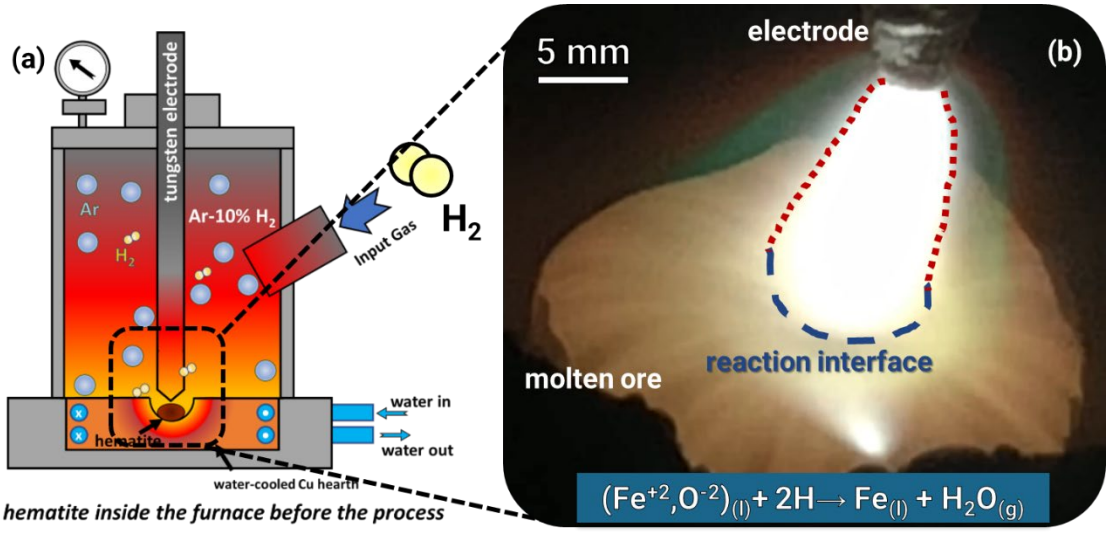

Figure 1 *– Principle of hydrogen plasma smelting reduction. (a) Schematic representation of the furnace used for HPSR purposes. (b) Image of the process, in which the ore gets simultaneously*

smelted and reduced by a hydrogen plasma. The chemical reactions (e.g., $FeO + 2H \rightarrow Fe + H_2O$) occur preferably at the reaction interface, the region between the plasma and the molten pool.

References

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