ADVANCES IN UNDERSTANDING OF REDUCTION PROCESSES IN EXTRACTIVE METALLURGY

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Abstract

Reduction processes at higher temperatures with carbon and hydrogen are widely used in industrial production of metal powders. Chemical reduction at lower temperatures usually involves the reduction of metal ions such as gold, silver and copper in some type of solvent and a separate reducing agent. This method is typically used for the preparation of magnetic metal nanoparticles, such as iron, cobalt, nickel and its alloys. In this process, metal nanoparticles are formed in aqueous solution by various reduction processes such as electrowinning, microwave reduction, and using various types of reducing agents and metal precursors such as metallic chloride and metallic nitrate. It allows controlling the particle size, morphology, and crystallinity, but requires costly precursors, toxic or hazardous solvents, chemical reductants like sodium borohydride or hydrazine, and stabilizers to prevent the aggregation of particles or to make them physiologically compatible. The ultrasonic spray pyrolysis (USP) is droplet generation phenomenon induced by ultrasonic field including its simplicity, cost-effectivity, continuous operation, and high deposition rate using an electrostatic filter. Synthesis of metallic, oxidic and composite powders is enabled using USP with hydrogen reduction. Reduction processes were also used in recycling of titanium from aluminium residues aiming iron removal in the first step of the research strategy. Reduction of iron oxides in solid state, at atmospheric pressure, is an already implemented industrial process that yields iron feedstock suitable for steel production in electric arc furnaces. Thermochemical modeling of reduction for bauxite residues containing iron oxides has been done by FactSage for hydrogen and carbon as reducing agents at 1700°C what is very important for the analysis of iron formation and mass losses.

Keywords: *reduction, hydrogen, carbon, ultrasonic spray pyrolysis, bauxite residues*