

Production of titanium powder directly from titanium ore by preform reduction process (PRP)

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Abstract

The preform reduction process (PRP) based on the calciothermic reduction of titanium ore was investigated. To develop a new process for producing metallic titanium powder directly from titanium ore, thermodynamic analyses for removing iron from the ore by selective chlorination were conducted before the experimental work. Titanium feed preform was fabricated at room temperature by casting slurry, which is a mixture of titanium ore (rutile  $\text{TiO}_2$  with impurities, e.g., iron), flux ( $\text{CaCl}_2$ ), and binder. The fabricated preform was calcined at elevated temperatures and iron was removed by selective chlorination. The obtained preform was then reduced using metallic calcium vapor as the reductant, and the reduced preform was subject to leaching to remove  $\text{CaO}$ ,  $\text{Ca}$ , and other impurities. When de-ironized rutile ore mixed with  $\text{CaCl}_2$  flux was reduced, metallic titanium powder with 99% purity was obtained. Thus, the PRP is feasible to produce titanium powder directly from titanium ore.

*Keywords: Preform reduction process (PRP), Calciothermic reduction, Titanium powder, Selective chlorination*