Hydrogen Processing of Ti6Al4V turnings for fabrication of fine powders for additive Manufacturing

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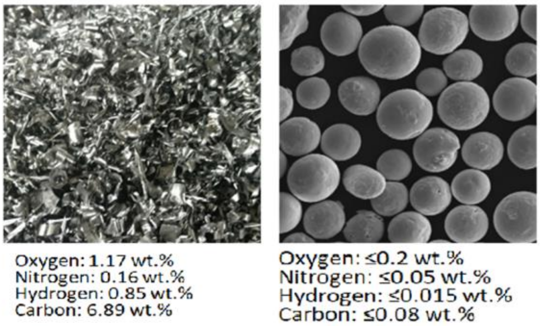
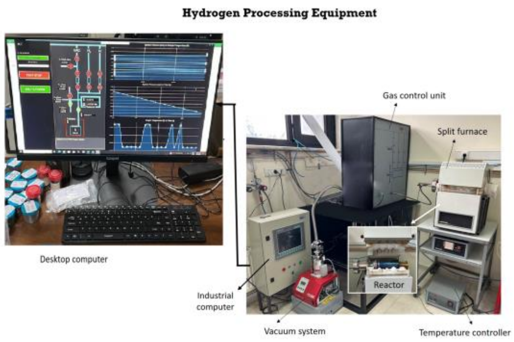
Ti6Al4V is widely used in aerospace, biomedical, and other industries due to itshigh strength-to-weight ratio, corrosion resistance, and high-temperature performance. Additive manufacturing (AM) enables near-net-shape production with significantly reduced waste. Among AM techniques, selective laser melting (SLM) is the most widely used for Ti6Al4V, and it requires fine (15–53 µm) spherical powders.This study investigates a recycling route to produce such powders from



Motivation is to recycle contaminated turnings into fine Grade 3 spherical powders(<53 µm)

Ti6Al4V shavings. In this route, cleaned chips are hydrogenated, milled, and plasma spheroidized into spherical powders. To determine conditions of hydriding, chips were hydrided isothermally for a fixed duration at temperatures from 450 to 650 °C. This showed that the amount of hydrogen absorbed increased with increasing temperature. Then, pressure-controlled experiments were carried out. This was challenging since hydrogen absorption leads to an uncontrolled rise in temperature. Hydriding, therefore, was carried out with flow-controlled delivery. This showed that chips can be hydrided to 3.3 wt.% at 400 °C for a duration of 5 hours. The hydrided chips were milled with a tumbling ball-mill, which resulted in powders of irregular shape (<53µm) due to their brittleness.

Iregularly shaped fine powders were sphereoidized in RF thermal plasma 25 kW. The powders were fed into the torch from 15 to 5 g/min. 10 g/min provided the best balance between spheroidization and process efficiency.



Equipment used for hydrogen processing of the turnings . The reactor where turnings are treated is inside the split furnace The equipment is a PCT apparatus (house built and impeoved over aperiod of 10 years).aapted for the purpose

It is concluded that direct spheroidization of hydrided powders in the plasma reactor results in desorption of hydrogen which adversely affact the temperature distribution in the reactor. Possible routes for succesful processing of plasma sphereoidization are discussed

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