Investigations on oxygen removal from molten TiAl scrap by metallothermic reduction

103 TITANIUM EUROPE2013

Casting scrap

Massive scrap

Feedstock
(production scrap)

Motivation:

- Complex process chain and production rejections of up to 90 % result in high production costs during manufacture of titanium aluminides
- Reducing manufacturing costs by recycling of strongly oxygenated scrap via:
  - ➡ utilization of industry-proven processes
  - ➡ highly flexible selection of input materials
  - ➡ in situ adjustment of the alloy composition

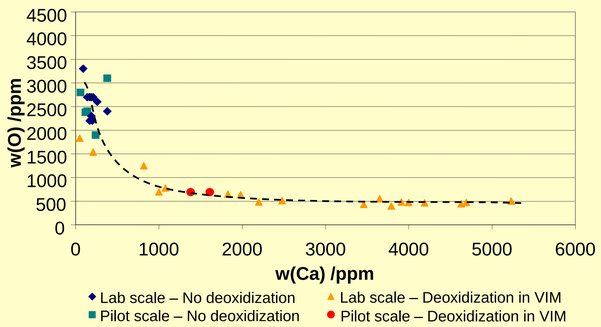
Vacuum induction melting

- Input material contains more than 1000 ppm oxygen
- Melting of the scrap in a ceramic crucible with subsequent homogenization
- Calcium addition for deoxidization results in formation of a CaO-slag
- Residual oxygen content of about 700 ppm

$[O]_{TiAl} + [Ca]_{TiAl} = <CaO>$

$[O]_{TiAl} + \{Ca\} = <CaO>$

< > solid [ ] liquid { } gaseous



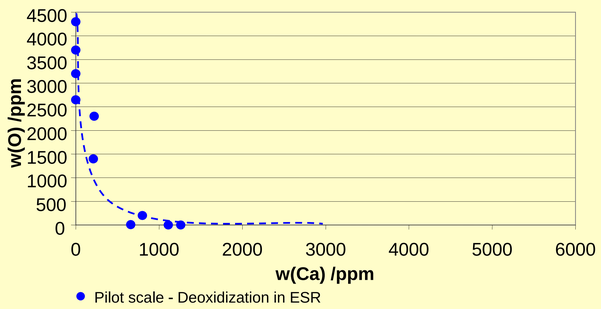
❍ Selection of suitable ceramic linings:

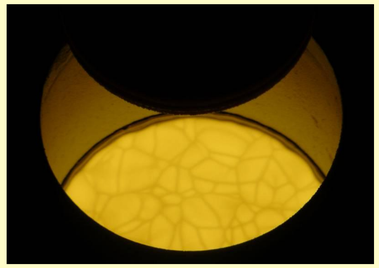
Y_2O_3 coated Al_2O_3:
➡ Flaking of Y_2O_3 coating

High purity CaO:
➡ Promising durability

Electro-slag remelting

- Remelting with a continuously activated reactive CaF_2-slag results in:
  - ➡ reduction of the oxygen content
  - ➡ removal of nonmetallic inclusions
  - ➡ almost no existence of shrinking holes
- Potential of bulk fluoridation
- Residual oxygen content below 500 ppm
- Further homogenization of the material

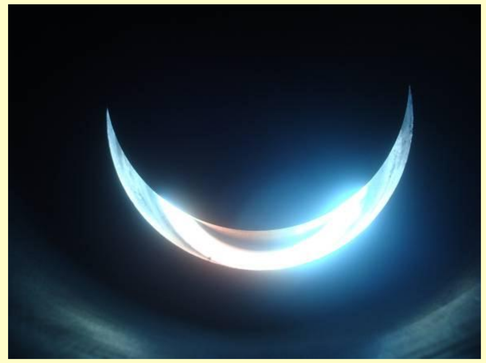




Electro-slag remelting

Vacuum arc remelting

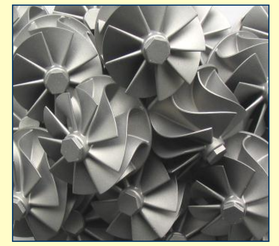
- Optional final remelting step in order to:
  - ➡ remove potentially objectionable calcium residues
  - ➡ remove last nonmetallic inclusions
  - ➡ adjust the designated crystal structure
- Safety remelting step with regard to existing standards



Vacuum arc remelting

Product

- Process results in high quality, cost-efficient, sustainable material for exemplary use in:



Turbocharger

Turbine Blades

Results:

- Oxygen content below 500 ppm can be achieved
- Potential of „bulk fluoridation“ existent
- Decrease of production costs of about 30 – 40 %

Dipl.-Ing. Peter Spiess
IME Process Metallurgy and Metal Recycling
RWTH Aachen University, 52056 Aachen, Germany
pspiess@ime-aachen.de www.ime-aachen.de

IME Metallurgie Prozesstechnik Recycling DIE METALLURGEN

AKR AACHEN KNOW-HOW CENTRE RESOURCE TECHNOLOGY

RWTH AACHEN UNIVERSITY