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**ABSTRACT**

Due to high scrap generation during the manufacturing of semi-finished and final products made from titanium and titanium alloys, recycling shows a great potential to substitute titanium sponge, economize the titanium market and to apply secondary low cost titanium in new applications. This article deals with the development of a new recycling process for Titanium-Aluminide scrap, which is presently downgraded as a deoxidation agent in steel production. This process is an innovative combination of industrialized processes like Vacuum Induction Melting (VIM), Metallothermic Desoxidation,

Pressure Electro Slag Remelting (PESR) and Vacuum Arc Remelting (VAR).

The preliminary melting of scrap is done by VIM using specialized ceramic linings and includes pre-deoxidization by metallothermic reactions. The second process step is final deoxidization by Pressure-ESR using a continuously activated Ca-reactive slag. Finally VAR removes small slag inclusions as well as dissolved Ca and allows for hydrogen degassing. For each step the special equipment requirements, the metallurgical challenges as well as opportunities are described. Thermochemical modeling on refractory reactions in contact with liquid titanium alloys, on the involved deoxidization by calcium metal, on the chemistry of deoxidation by active slags and on the removal of excess Ca and H in VAR are presented in the fundamentals section.

The paper will show, as a significant innovation for the Titanium industry, the results of semi-pilot scale experiments at IME for the production of 30 kg VIM-PESR-VAR-ingots from 100 % scrap regarding process window definition and material characterisation. The presentation will close with a cost benchmark estimation against primary TiAl-production.

*Biography*

Bernd Friedrich received his Diplom-Engineer degree in 1983. He attended RWTH Aachen University from 1978 - 1983 and studied non-ferrous metallurgy. From 1984 until 1987 he was a Scientist at IME Process Metallurgy and Metal-Recycling, RWTH Aachen University. Mr. Friedrich received his Dr.-Ing. with his dissertation on "electrolytic refining of recycling-tin using three dimensional-electrodes."

Since 1999 Bernd has been the director of IME Process Metallurgy and Metal Recycling, chair and department of the RWTH Aachen University. His areas of specialisation are: vacuum metallurgy, electrometallurgy, plasma-technology, metallurgy of special metals (e.g. refractory metals), technology of alloys, metal powders, hydrometallurgy, sustainable recycling processes, waste water and residue treatment, applied electrochemistry and electroplating.

For four years prior to the position at RWTH Aachen University he was plant manager with NiCad/NiMH at Varta Batterie AG in Hagen/Germany and Ceska Lipa/Czech. Republic. He was head of the R&D-center, innovative rechargeable battery systems, and the R&D-coordinator for 3C-Alliance (Varta-Toshiba-Duracel).

He was head of the profit center for hydride-technology and advanced materials at GfE, Nuremberg/Germany from 1992 until 1995, but began his impressive career in 1988 where he was head of R&D-department at GfE, Nuremberg/Germany (refractory metals, ferro-alloys, advanced materials, metal-recycling and residue-utilisation).