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PREFACE

This special issue includes papers from presentations at the 6th International Round Table on Titanium Production in Molten Salts (TiRT6). The conference was held from 10–13 June 2018 at Reykjavik University, Reykjavik, Iceland. Titanium Round Table conferences have previously been held in Cologne in Germany (2008), Trondheim-Tromsø in Norway (2010), Cambridge in the UK (2012), Shanghai in China (2014) and Hokkaido in Japan (2016). 32 scientists participated in the TiRT 6, the majority coming from Japan and China. 25 contributions were given as oral presentations, of which 12 from China, 10 from Japan, 2 from Oman as well as contributions from UK, Iceland and Norway. The main goal of the series of these round table conferences is to gather experts to discuss possibilities to develop a new and more sustainable process for primary production of titanium based on electrochemical approaches using molten salt electrolytes.

Currently metallic titanium is still produced by the Kroll method, which involves chlorination of titanium oxide, purification of $TiCl_4$, and thermic reduction using magnesium and the molten salt electrolysis of by-product $MgCl_2$. The main drawbacks of the Kroll process are high energy consumption, slow production rate resulting in high cost. The most famous approach to possibly replace the Kroll process has been the FFC Cambridge process which has created a lot of interest and many new research activities over the past 20 years. However, due to low reaction rate and low efficiency industrialisation of the process has been limited to production of special products such as metallic titanium powder.

TiRT6 has continued the discussion of possibilities to develop a new process for titanium production. Several interesting papers were presented by many established research groups in this field. Several participants have attended many of the previous 5 conferences. The conference also allowed for contributions not directly related to titanium production, such as a study of negative electrode for lithium ion battery. Results from experimental studies of important aspects of raw materials were also presented. In this context production of rutile, carbochlorination of titanium oxide and preparation of ferrotitanium and titanium sulfide as alternative raw materials were also included in presentations. Another important aspect of titanium is recycling of scrap, which was also given as an interesting presentation. The production of titanium aluminium alloys is another alternative approach which was included as two different contributions.

The main challenges for successfully developing a new and more sustainable and less costly process have been largely related to the fact that titanium may occur in several different valence states that are stable under certain conditions in molten salts. Spontaneous disproportionantion reactions have caused many problems and led to poor efficiency for titanium production. The raw material is usually Ti (IV), and Ti (III) and Ti (II) are also stable valence states. A promising approach is to produce a titanium containing liquid alloy. In this case the valency problem may be overcome since the codeposition of titanium is facilitated. However, such a process route will involve one more step to remove and recycle the liquid metal that titanium forms an alloy with. Bismuth is one such candidate metal having a low melting point and possibility to be separated and recycled by distillation. Another interesting approach is to develop a process for electroplating of titanium by electrodeposition from molten salts. Laboratory experiments in mixed molten chloride/fluoride electrolytes seem very promising. An original idea to utilise the reactions between various valencies of titanium to produce titanium powder was also presented.

Previous round table conferences have also included studies in ionic liquid electrolytes as well as participation from scientists working in the titanium industry. It is expected that the future round table conferences may be considered more important by the research community including the titanium industry, since titanium has exceptional properties but limited applications. It may also be expected that studies of production of similar metals such as tantalum and niobium may be included in future research and coming conferences. An interesting suggestion is to try to establish a real international collaboration project with funding from several countries.

As usual the participants took part in a vote concerning various aspects of the possibilities to develop a new process. The vote was initiated at the first round table conference and concerns many key questions about future routes for a new titanium process. It is named the Democratic Titanium Process (DTP). The conference also included excursions to industrial plants for production of aluminium and ferro silicon as well as a visit to a geothermal plant and a swim in the Blue Lagoon.

It was decided that the next round table conference will be held in China in 2020. The details of time and location will be decided at a later time.

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