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Special Issue on New Proposals on Titanium Production and Molten Salts

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PREFACE

This special issue consists of some review papers and original papers, including the studies presented at the 5th International Round Table on Titanium Production in Molten Salts (Ti-RT2016)[1]. This conference was held on 10–14th July 2016, both at Hokkaido University, Sapporo and at Toya Cultural Center, Toya-ko-town, Hokkaido, as a series of conferences previously held in Cologne in Germany (2008), Trondheim-Tromsø in Norway (2010), Cambridge in the UK (2012) and Shanghai in China (2014).

Currently metallic titanium is produced mainly by Kroll method, which is constructed from chlorination of titanium oxide, purification of $TiCl_4$, its thermic reduction using Mg and the molten salt electrolysis of by-product $MgCl_2$. As increasing demand of pure Ti from various industries, more cost-affordable process is requested from the end-users. Molten salt electrolysis to produce metallic Ti was previously predicted by Dr. Kroll as the most suitable method, finally replacing his own well-known and successfully commercialized process. Therefore, molten salt technologies have been widely studied as an alternative method in the titanium extraction and refining.

The International Round Table on Titanium Production in Molten Salts has discussed the possible choices for future realization. Ti-RT2016 provided such a unique opportunity for the researchers, both in academia and industry, to exchange their scientific ideas on new titanium refining (RT) process while surrounding the "round table" (RT). Presentations on new ideas and concepts related to the general field of refining, such as the reduction of the oxides of Ta, Nb, V and rare earth metals, were also invited, aiming to understand the reactions in the molten salts commonly used. Attempts to obtain Ti and its alloys without molten salt techniques are likewise encouraged, in order to get a broader overview of the development of new refining processes. Novel methods to obtain Ti from room temperature ionic liquids (RTIL) are also welcome. The pre-treatment and post-treatment of molten salt reactions are further subjects of discussion. From the mix of these new topics we expect to get an outlook on the future of titanium production in molten salts.

Under these objectives, Ti-RT2016 gathered 85 participants and 40 presentations from Japan (approximately 33%), China (33%) and the other 6 countries (33%). The tradition of providing an interactive environment for speakers and audience was kept as a style of round table so that all the attendants surrounding the table can discuss these topics and concepts.

Highlights in this conference were reported separately[2,3]. Some attempts to reduce the titanium oxide at the cathode should optimize the possible operation parameters by considering the design of industrial application. TiO anode was extensively examined to decrease electric consumption. Combination of hydrogen and magnesium is applied with the molten salt. Some intermediate compounds such as titanium mono-oxide, sulfide, tri-chloride and $CaTiO_3$ were studied as the alternative of $TiCl_4$ in Kroll method. Various kinds of molten salt were tested. However, no universal agreement has been reached since these attempts still remains in laboratory scale. The attainable oxygen level is still high for the structural material. As a characteristic of this conference, the voting by all the attendants decided a new proposal so-called "democratic titanium process (DTP)", although no logical consistency was guaranteed. This special issue contains a part of DTP, which triggers the next new proposals.

All the papers submitted to Ti-RT2016 are considered to be the articles suitable for publishing in this special issue, in addition to the new articles related with these DTP topics especially recommended. We expect this special issue will enhance the developement of the researches and exchange ideas on the basic knowledge of titanium production in the molten salt.

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1) http://www.eng.hokudai.ac.jp/TiRT2016/index.html
2) R.O. Suzuki: Titanium Japan **64** (2016) 270–277, **65** (2017) in press (in Japanese).
3) R.O. Suzuki: Molten Salts **59** (2016) 127–133 (in Japanese).