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Titanium Production with the DeOx Process

Ole S. Kjos
Department of Materials Technology

Supervisor:
Geir Martin Haarberg

Outline

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- Experimental
- Results
- Conclusion
- Thanks

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Background

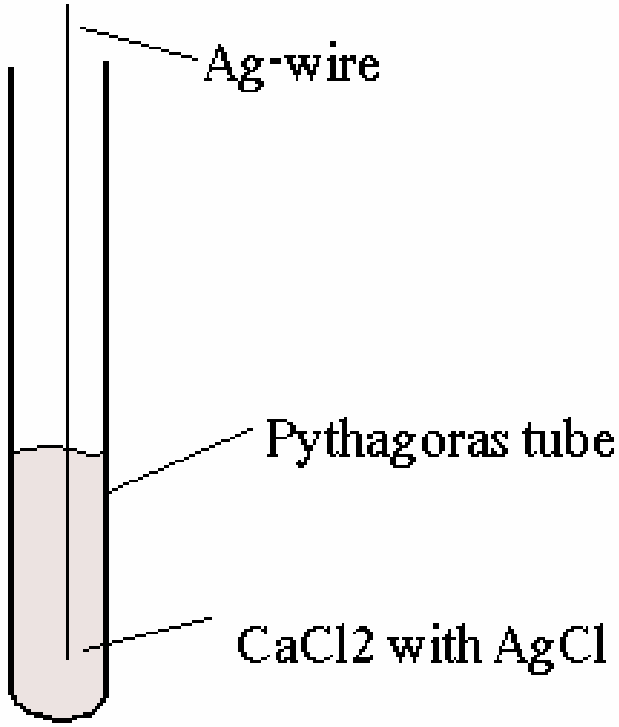
- There is a worldwide need for titanium
- Cheaper titanium would increase demand even more
- New, and more efficient ways of producing titanium are needed.

Experimental

- All experiments were conducted in a closed laboratory furnace with argon atmpsphere.
- The experiments were conducted with about 150g of $CaCl_2$ based melt at 900 ^oC.
- 2.5 - 3g TiO_2 was used as cathode preform.
- Carbon was used as anode.

Reference electrode

- Ag/AgCl system was used as a reference.
- It was held in a mullite tube, sealed in the lower end.
- Reversible potential VS Ca-deposition from $CaCl_2$ melt was calculated to be about 2.2 V.



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The experiments

- First some experiments were done with constant cell-voltage at 3V.
- After the experimental setup was tested several experiment were conducted with a potensiostatic cathodic voltage of 1.4 V VS Ag/AgCl-reference.
- The same set of experiments was repeated with 1.8 V cathodic voltage.

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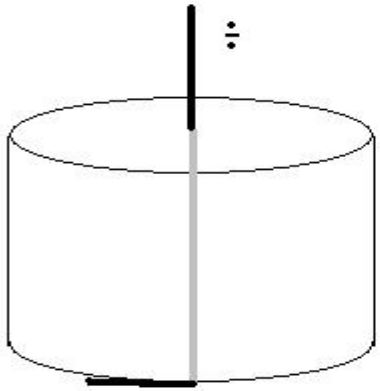
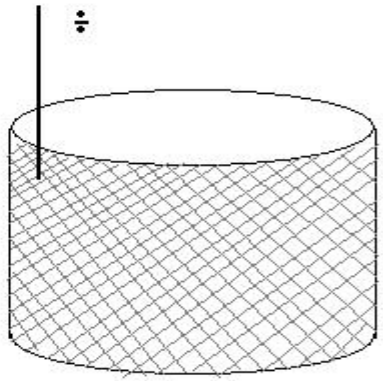
The experiments

- For each catodic voltage changes in the cathode assembly were made.
- After the experiments the final product was analysed by WDS or XRD.





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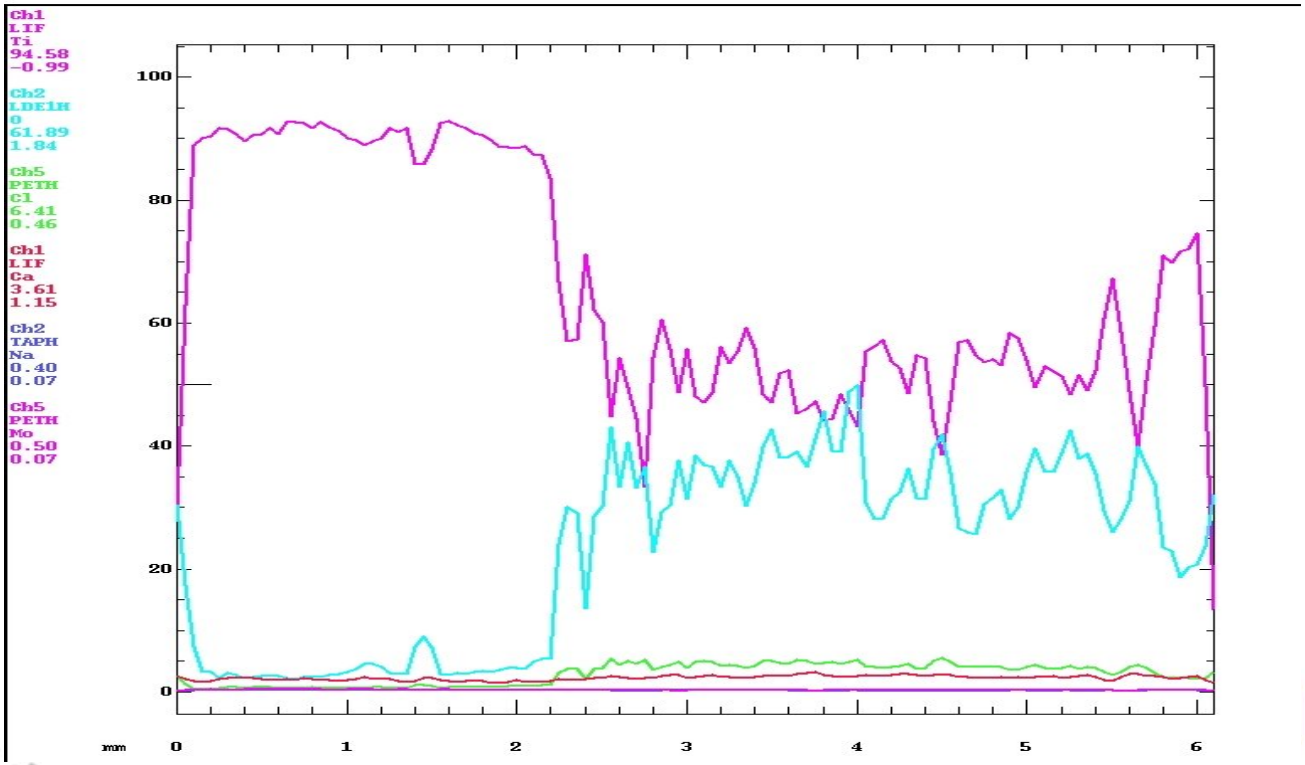
Results

– At 3 V cell voltage metallic titanium was produced. This is in agreement with literature.



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Results 1.4V

- At 1.4 V cathodic potential no metallic titanium was produced.
- At the start of the experiment the current was high (1-2A), but it rapidly decreased and stabilised at about 0.2A.
- The cathode was distinctly separated in two phases; calciumtitanat and titaniumoxide.
- No difference after 24 or 48 hours

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Results

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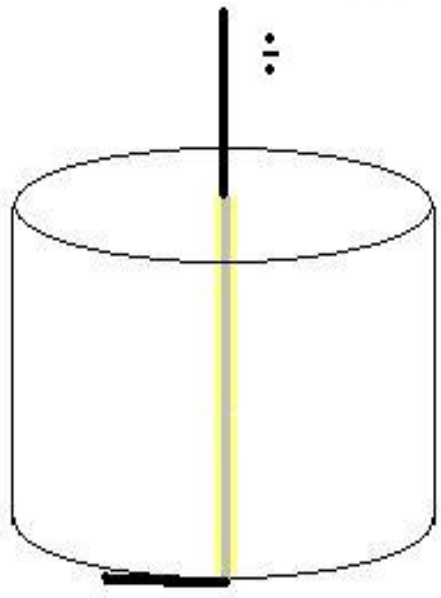
Results

- The calciumtitanate phase was always formed in the center of the pellet.
- The shell on the outer side of the pellet wa always titanium oxide.
- The size ratio between them was similar when the size of pellet was changed.
- This did not change when the current was led through a mesh around the pellet.



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Results

- Probably spontaneous formation of calciumtitanate, and removal first happens around the edges.
- Results for 1.8 V cathodic voltage is practically identical to those from the 1.4 V series.
- Last run was 1.8 V for 24 hours, and then 2.0 V for 24 hours. This experiment gave metallic titanium, but with some oxygen.

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Conclusion

- It is possible to produce titanium metal with a DeOx-process.
- It was not possible to produce metallic titanium with 1.4 V or 1.8 V VS Ag/AgCl.
- Calciumtitant-formation is probably spontaneous, but does not seem to be a problem.
- Changes in cathode size and metode for current connection done in these experiments did not result in significant changes in the product.

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