# REDUCTION OF $^{50}$TI DIOXIDE TO $^{50}$TI METAL

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## BACKGROUND

- New particle accelerator experiments require isotopically enriched metals
- $^{50}$Ti and various lanthanides are desirable for use as beam material and target material respectively
- Isotopically enriched metals are only available as metal oxides or chlorides
- The creation and use of an induction heating system allows for the reduction of a wide variety of enriched metal oxides to the respective pure metals
- $^{50}$Ti beams and lanthanide targets are desirable in research and medical purposes

## METHODS

- To successfully and efficiently reduce a metal oxide, the correct chemical pathway must be chosen
- Due to evolution of hydrofluoric gas in lanthanide reductions, initial testing used the $^{50}TiO_2$-$CaH_2$ reduction route to guide the construction of the system
- The furnace system utilizes an induction heater, vacuum pump, and inert gas flow to adapt to many different requirements
- Initial test heating used copper, aluminum, and molybdenum in standard atmosphere
- An infrared sensor, thermocouple, and pyrometer was used to measure the temperature of the system

## RESULTS

- All components verified as operational, system holds a 30 in Hg vacuum
- Test melting with copper metal showed no signs of oxidation under vacuum conditions
- Operational with both pure metal in alumina crucibles and metal oxides in tantalum crucibles
- System was calibrated to 950 °C at the bottom of the crucible for use in future titanium reduction
- Stray EMF heated undesirable sections of metal, limiting operational time


## CONCLUSION

- Operation of an induction furnace system would assist in future research and medical endeavors
- This system is verified to meet the requirements of temperature, pressure, and adaptability for a wide range of metal oxide reductions
- Further work will produce isotopically enriched titanium and lanthanide metals
- Further testing will ensure stray EMF heating is reduced through the use of a smaller coil

Lommel, B., Beusch, A., Hartmann, W., Hübner, A., Kindler, B., Steiner, J., & Yakusheva, V. (2013). Reduction of isotopically enriched 50Ti-dioxide for the production of high-intensity heavy-ion beam. *Journal of Radioanalytical and Nuclear Chemistry*, *299*(2), 977–980. https://doi.org/10.1007/s10967-013-2615-7

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