HBNI Alumni Webinar

Friday,
January 30, 2026
at 5:00 PM

Venue:

HRDD Hall , First Floor,
Training School Complex,
Anushaktinagar,
Mumbai

Link of : -

YouTube:
https://youtube.com/live/B2nTsg8xIPk?feature=share

Webex:
https://hbni.webex.com/hbni/j.php?MTID=m80ac2ccb0a67bfecdd18caebbfda5e94

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"Preparation of Volatile Rare Earth Metals (Sm, Eu, Tm, Yb) by Vacuum Reduction–Distillation: Thermodynamic Analysis"

I am serving as Scientific Officer/F at the Bhabha Atomic Research Centre (BARC), Mumbai, with experience in hydrometallurgical and pyrometallurgical process development, supported by theoretical and experimental expertise. I obtained my Ph.D. from the Homi Bhabha National Institute (HBNI) in Jan. 2017. The title of my doctoral thesis was "Synthesis, Evaluation, and Theoretical Studies of Calix-Crown-Based Ligands for Cesium Recovery from Acidic Media.". My work in hydrometallurgy includes the design and synthesis of novel ligands, particularly Cs specific calix-crown compounds, for applications in the back end of the nuclear fuel cycle. I have experience in density functional theory (DFT) calculations using TURBOMOLE and GAMESS software to obtain thermodynamic insights into metal-ligand interactions.

In the area of pyrometallurgy, I have experience in the preparation of high-purity reductants such as calcium (Ca) and magnesium (Mg) through reductive distillation routes. I have worked on the production of aviation-grade titanium sponge from feedstocks including titania slag and synthetic rutile using the Kroll process. My contributions also include the design, fabrication, and operation of an indigenous setup for the preparation of ilmenite slag from ilmenite via submerged arc smelting, followed by $TiCl_4$ production through high-temperature carbochlorination.

Abstract

Most rare-earth metals are produced by molten-salt electrolysis or metallothermic reduction at ambient pressure. However, samarium (Sm), europium (Eu), thulium (Tm), and ytterbium (Yb) require special methods due to their low boiling points. Ellingham diagrams show their oxides are more stable than common reductants (H_2, Al), making reduction thermodynamically not feasible. Carbon reduction is only feasible at very high temperatures (>2200 ˚C) and is hindered by carbide formation. Calcium (Ca) can reduce all four oxides, yet its volatility causes metal loss, especially for Eu and Yb. Lanthanum (La) with low vapor pressure remains the only practical reductant under high-temperature and vacuum conditions. Thermodynamic calculations, supported by experimental validation, confirms the feasibility of lanthanum-driven reduction of Sm_2O_3, Eu_2O_3, Tm_2O_3, and Yb_2O_3. In the temperature range of 1000-1200 ˚C, the equilibrium vapor pressure of the reduced metals lies in the order of 10^{-3}-10^{-4} mbar, which can be attained using a diffusion pump (DP). The vaporised rare earth vapours can then be condensed at predetermined zones by optimizing condenser design.

All are cordially invited for in person attendance