PRELUDE

The lanthanide series elements, both as naturally occurring mixtures and as separated elements and compounds, have shown promises in varieties of applications as industrial catalysts, ceramics glass materials, electrical and optical components, high temperature superconductors, phosphors X-ray intensifying materials, etc. The nuclear properties of rare earth elements are now being utilized now in the field of nuclear medicine. ^{144}Ce and ^{159}Gd are used in bone marrow scanning, ^{147}Pm impregnated on various metals is applied as X-ray radiation source, etc. For *in-vivo* or other type of sophisticated applications, carrier-free radioisotopes of rare earth elements are always preferred to their counterpart neutron irradiated low specific isotopic radioactivity.

However, separation of rare earth elements, specially of a carrier-free rare earth from another bulk rare earth is always a colossal task, perhaps the single most difficult task in analytical chemistry due to their pronounced congenericity.

The present thesis deals with the problem of radiochemical separation of some important radio-lanthanides in their carrier-free states produced through nuclear activation reactions.

The approach in the Section 1, containing only first chapter of the dissertation, is general in nature. Qualitative discussions have made on carrier-free radioactivity and its various production roots with special emphasis on charged particle activation. Discussions have been made on particle accelerators and γ-ray spectroscopy. The various methods of radiochemical separations have also been described in brief. Importance of carrier-free radionuclides of lanthanide series elements in the field of nuclear medicine has been stressed. The genesis and scope of the present problem has been searched from an extensive literature review of the work carried out on the production, separation and application of carrier free radionuclides.

The Chapter 2 in Section 2 describes the production of various carrier-free radionuclides using proton as a projectile. The Section 2 finds the logical conclusion of heavy ion irradiation in Interlude 1.

The Section 3 is the heart of the thesis which contains six chapters, chapter 3 to chapter 7. The chapter 3 describes the feasibility of carrier free radionuclides production by theoretical and while in chapter 4 experimental simulation works on the separation of carrier-free rare earth produced by heavy ion activation have been described. Chapter-5 describes the general experimental set up for heavy ion irradiation, while the sixth to eighth chapters describe the production of carrier-free radionuclides using heavy ions, e.g., C^{6+}, O^{7+} and B^{5+} as projectiles.

Finally, in Section 4 and chapter nine, the thesis ended with a conclusion of the developed radiochemical charged particle activation procedures.