CHAPTER I
INTRODUCTION

Corrosion of materials is one of the major concerns in many applications and industries. As a result of its corrosion behavior, damage of a particular component can be enormous. Many types of corrosion can occur on material used in the nuclear industry but one of the major concerns is stress corrosion cracking (SCC). To estimate material corrosion rates and behavior in elevated temperature and pressure environments, an appropriate measurement must be applied. This is commonly done using electrochemical techniques since corrosion is an electrochemical reaction. All electrochemical measurements make use of a reference electrode and, in high temperature/pressure conditions. External Pressure Balanced Reference Electrodes (EPBRE) are commonly employed. An EPBRE is required for various measurements such as linear polarization, potentiodynamic polarization, impedance spectroscopy and simple electrochemical corrosion potential measurement. The corrosion potential of a material in high temperature aqueous solution is a key parameter for evaluating the corrosion behavior of the material.

One of the most widely used reference electrodes is the Silver-Silver-Chloride (Ag/AgCl) reference electrode. Due to its ease of construction and fair tolerance under high temperature and pressure applications, this type of reference electrode has been used in many industrial applications. However, the presence of corrosive elements such as chloride ion (or any other halogen ions) is a major concern in industrial applications. As chloride ions are damaging to many parts in the system, huge amounts of operation and maintenance expenses may be incurred. To avoid using chloride ions associated with reference electrodes, a lithium ferrite electrode is introduced in this work. This type of reference electrode is selected for the use in the primary coolant system of nuclear reactors. Lithium and boron are the major chemical additives in a reactor coolant system. Thus by using a lithium-based reference electrode a separate compartment and filling solution are no longer required. Lithium iron oxide has become an important topic with regard to its application as a low cost substitute for garnet and other materials for microware applications. Various preparation methods of lithium ferrite have been developed such as hydrothermal ball milling (Ahniyaz *et al.,* 2002), freeze-drying method (Bonsdorf *et al.,* 1995), flux method (Xu *et al.,* 2003) and the sol-gel method (An *et al.,* 2005). In general, spinel-type lithium-ferrite is synthesized and occurs in two forms. The two forms are ordered and disordered crystal structure. These two structural forms are produced depending on the quenching time during the process. With a rapid quenching procedure, the disordered lithium ferrite is formed, while the ordered lithium ferrite is formed when slow cooling is applied.

In this study, lithium ferrite is synthesized and coated on to a substrate and then used as reference electrode in simulated nuclear reactor coolant. In addition, the thermodynamics and kinetics of the lithium iron oxide redox reaction are proposed and validated.