Linköping Studies in Science and Technology Dissertation No. 840

# Radiation Chemistry of Aqueous Solutions Related to Nuclear Reactor Systems and Spent Fuel Management

**Tim Lundström**

**Akademisk Avhandling**
som för avläggande av filosofie doktorsexamen vid Linköpings Universitet kommer att offentligt försvaras i hörsal Planck, Fysikhuset, Linköpings Universitet, måndagen den 15 september 2003, kl 10.15.

**Fakultetsopponent**
Docent Mats Jonsson, Institutionen för kemi, avdelningen för kärnkemi, Kungliga Tekniska Högskolan, Stockholm

## Abstract

In this thesis the rate constants for a number of radical reactions in aqueous solution have been studied in a wide temperature range. The reactions of H with $H_2O_2$, OH and $HO_2$ and the reactions of $HO_2$ with OH, $Fe^{2+}$ and $Cu^{2+}$ have been studied.

For each reaction rate constants have been determined as a function of temperature using the technique of high temperature, high pressure (HTP) pulse radiolysis. The rate constants were obtained by fitting a kinetic computer model to the experimental data. From an Arrhenius plot the activation energy of each reaction was determined. The data determined in this way are important for modeling of radiolysis in nuclear light water reactors.

A previously developed model for calculation of the effect of water radiolysis products on oxidation and dissolution of spent nuclear fuel has been improved. In the new model, called TraRaMo, simultaneous transport by diffusion and chemical reactions induced by radiolysis can be modeled. The model is a compartment model. After a radiolysis calculation in each compartment, diffusion of the species are allowed to take place before a new radiolysis calculation in the next time step. Three different types of radiation can be simulated simultaneously.

Department of Physics and Measurement Technology, Biology and Chemistry
Linköpings Universitet, SE-581 83 Linköping, Sweden

Linköping 2003

**ISBN 91-7373-724-0** **ISSN 0345-7524**