Influence of Temperature on Thermodynamic Property of Germanium in Hydrogen Peroxide Solutions

Apeksha Gupta, Atul Shukla, S Noyel Victoria, R Manivannan*
Department of Chemical Engineering, National Institute of Technology Raipur (C.G), India.
** Corresponding author: R Manivannan Email: rmani.che@nitrr.ac.in*

Abstract

Germanium (Ge) is considered as a promising candidate to replace Si in the future metal oxide semiconductor field effect transistor (MOSFET) devices, due to its higher electron and hole mobility [1]. Excess Ge, after deposition in the device manufacturing, needs to be removed during chemical mechanical planarization process using slurry containing the oxidizing agent [2]. Hydrogen peroxide (H_2O_2) is widely used oxidizer to remove the excess germanium. However, the thermodynamic behavior of germanium in hydrogen peroxide system was not studied. In this study, the germanium etch rate (ER) experiments were performed at different temperature in the presence of 0.1 wt% hydrogen peroxide at natural pH. The duration of etch rate experiment was maintained for a min. An increase in etch rate was found with increase in temperature and the thermodynamic properties of the system were investigated. The semi-logarithm plot of etch rate and 1/T is shown in Fig. 1. The activation energy for germanium dissolution in hydrogen peroxide system is calculated by using Arrhenius equation and is found to 33.31 kJ/ mol. The enthalpy and entropy of activation for germanium dissolution in hydrogen peroxide system are evaluated from the plot of log (*ER*/*T*) versus 1/*T*, as shown in Fig.2. Thermodynamic property of germanium in the proposed system will be reported.

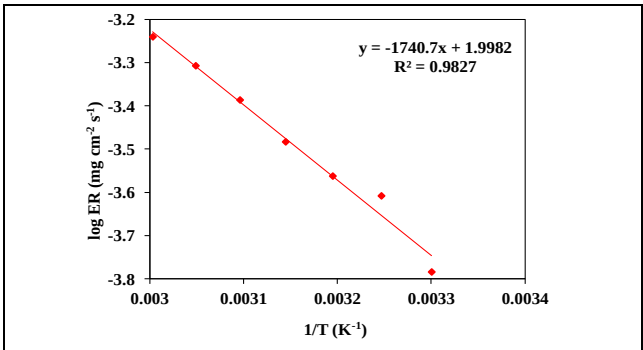

Fig. 1: Plots of log (ER) vs. 1/T for germanium dissolution in 0.1 wt% H_2O_2 solution.

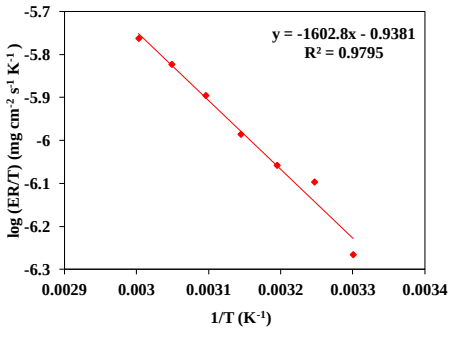

Fig. 2: Plots of log (ER/T) vs. 1/T for germanium dissolution in 0.1 wt% H_2O_2 solution.

References:
1. *S. Peddeti, P. Ong, L.H. Leunissen and S.V. Babu, Microelectron. Eng. 93, (2012) 61-66.*
2. *P. Ong, L. Witters, N. Waldron and L.H.A Leunissen, ECS Trans. 34, (2011) 647-652.*