4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

In Situ Surface-enhanced Raman Analysis of Water Libration on Silver Electrode in Various Alkali Hydroxide Aqueous Solutions

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Accepted for publication on 8th April 2015

In electrochemistry, it is often necessary to conduct both experimental and theoretical investigations, including analysis of the standard electrode potential, the electric double layer, the diffusion layer, the diffusion coefficient of the ion, and thermodynamic parameters. The accumulation of this vast array of electrochemical data forms the basis of contemporary research on electrochemical devices such as batteries, capacitors and fuel cells. The electric double layer in aqueous solutions composes solvated ions and water molecules, additionally and occasionally composes specifically adsorbed atom and contact adsorbed atoms. Considering the electric double layer in aqueous solution, one of the fundamental issue is the dynamical motion of water molecules at the double layer region. In order to investigate this issue, focusing the vibration of water molecules at the double layer region is necessary. The vibration of water molecules includes several vibrating modes; translation, libtation, bending vibration, stretching vibration and so on. Specially, the libration of water molecules may decide the water structure at the double layer.

Spectroscopy has progressed remarkably in the last three decades. Advances in spectroscopic analysis have been driven primarily by the need to clarify how surface physical chemistry, such as catalysis and corrosion, are involved in chemical reactions. The present study investigates the behavior of water molecules on the surface of a Ag electrode by Surface-enhanced Raman scattering (SERS) spectroelectrochemistry and focuses on the dynamical changes in the Raman spectra of water libration at the interface between the electrode and the electrolyte solution at various electrode potentials in alkali hydroxide aqueous solutions.

Keywords: Surface-enhanced Raman scattering (SERS), Spectroelectrochemistry, Water Libration, Silver Electrode