Measurement of Thermal Conductivity of Tetra-n-butyl Ammonium Bromide (TBAB) Semi-Clathrate Hydrate by the Transient Hot-Wire Method using a Parylene-Coated Probe

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The present paper reports measurements of the thermal conductivity of electrically conducting liquids by the transient hot-wire (THW) method using newly developed “parylene”-coated probes. In the present apparatus, a metallic wire coated a thin electrical insulation layer has been used both as a heating element and a resistance thermometer instead of a bare metallic wire. A parylene-coating method is applied to coat the metallic wire. In this method, conformal poly thin films are obtained by a chemical vapor deposition (CVD) process. This method has been tested by measuring water at room temperature under atmospheric pressure. The uncertainty of the thermal conductivity measurement is estimated as to be ±2 %. By using the present apparatus, we have measured the thermal conductivity of Tetra-n-Butyl Ammonium Bromide (TBAB) semi-clathrate hydrate. Semi-clathrate hydrate is expected to be useful applications, for example using as a heat storage agent and gas separator. However, there is little knowledge about TBAB hydrate characteristics. Up to the present, few experimental data about its thermal conductivity have been reported. Thermal conductivity is necessary for the evaluation of industrial formation process of semi-clathrate hydrate and heat transfer performance of semi-clathrate hydrate used as thermal energy storage agent. In the present study, the measurements have been performed on both TBAB solution and TBAB semi-clathrate hydrate at atmospheric pressure. The samples were made by cooling a solution that was made by dissolving TBAB powder into distilled water. The mass fraction of TBAB is 40 %. It is found that the thermal conductivity of TBAB semi-clathrate hydrate in 278 K is 24 % smaller than that of methane clathrate hydrate at 263 K, and 85 % smaller than that of ice at 273 K.