60° C. The test protocol consisted of applying a voltage from an external source and measuring the current produced by the electrochemical reaction. When no reaction occurs, no current flows through the electrochemical cell. If the voltage is sufficient to initiate a reaction, a current develops in the cell. The greater the magnitude of the current, the greater the rate of reaction and the greater the rate of hydrogen production.

[0064] The test results are provided in **FIG. 2** herein which shows a plot of the current that develops in the electrochemical cell as a function of the voltage applied by an external source. The curve labeled "Water/KOH" is the result obtained for the electrolysis reaction of water in the presence of KOH conducted in the comparison cell and the curve labeled "Methanol/KOH" is the result obtained for the electrolysis reaction of methanol in the presence of KOH conducted in the testing cell. The results for the electrolysis reaction of methanol in the presence of KOH have not been corrected for the Ohmic resistance of the testing cell. The results for the electrolysis reaction of water in the presence of KOH have not been corrected for the Ohmic resistance of the comparison cell.

[0065] The results for the electrolysis reaction of water in the presence of KOH show that current is not produced in the comparison cell until the magnitude of the voltage is increased to about 1.4 V. Absence of a current at voltage magnitudes below about 1.4 V indicates that the water electrolysis reaction does not occur at those voltages. Initiation of the reaction occurs at a voltage magnitude of about 1.4 V and acceleration of the reaction occurs upon further increasing the voltage magnitude above about 1.4 V. These results indicate that voltage magnitudes at or above 1.4 V are needed to produce hydrogen from the electrolysis reaction of water in the presence of KOH conducted in the comparison cell.

[0066] The results for the electrolysis reaction of methanol in the presence of KOH show that the reaction already takes place at zero voltage conditions. In other words, the electrolysis reaction of methanol in the presence of KOH occurs spontaneously in the absence of an applied voltage. The results further indicate that application of a voltage acts to accelerate the reaction. These results indicate that appreciable rates of hydrogen production occur in the electrolysis reaction of methanol in the presence of KOH conducted in the testing cell at voltage magnitudes at or above 0V.

[0067] This example shows that hydrogen production from the electrolysis reaction of methanol in the presence of KOH occurs at substantially lower voltages than hydrogen production from the electrolysis reaction of water in the presence of KOH.

EXAMPLE 3

[0068] In this example, the production of hydrogen from methanol and water in the presence of KOH at 23° C. and 60° C. is demonstrated. The reaction at each temperature was completed in a testing electrochemical cell that included an anode, a cathode, and an electrolyte solution assembled within a 250 mL beaker. The anode included 20% Pt supported on a Toray paper substrate. The geometric area of the electrode was 4.1 cm^2. The cathode was identical in design to the anode. The anode and cathode were separated by 5.5 cm in the testing electrochemical cell. The electrolyte solution consisted of a 100 mL portion of a solution formed by combining 250 mL methanol, 125 mL water, and 250 g KOH in a separate beaker. The KOH dissolved in the solution to provide hydroxide ion. The concentration of KOH in the electrolyte, expressed in molarity, is 9 M. The KOH was used as received from the vendor and may include adsorbed or hydrated water.

[0069] For comparison purposes, an analogous electrochemical cell without methanol was constructed. The electrolyte in the comparison cell consisted of a 100 mL portion of a solution formed by combining 225 mL H_2O and 250 g KOH. The KOH dissolved in the water to provide hydroxide ion. The concentration of KOH in the electrolyte, expressed in molarity, is 12 M.

[0070] Except for the electrolyte, the comparison electrochemical cell was identical to the one used for the reaction of methanol with KOH in the testing electrochemical cell. In the comparison cell, the electrochemical reaction is the electrolysis of water in the presence of KOH.

[0071] Once assembled, the testing and comparison electrochemical cells were tested for electrochemical activity at 23° C. and 60° C. The test protocol consisted of applying a voltage from an external source and measuring the current produced by the electrochemical reaction. When no reaction occurs, no current flows through the electrochemical cell. If the voltage is sufficient to initiate a reaction, a current develops in the cell. The greater the magnitude of the current, the greater the rate of reaction and the greater the rate of hydrogen production.

[0072] The results obtained for the testing and comparison cells are provided in **FIG. 3** herein which shows a plot of the current that develops in each electrochemical cell as a function of the voltage applied by an external source. Curves are shown at 23° C. and 60° C. for each cell. The curves labeled "Methanol/H_2O" is the result obtained for the electrolysis reaction of the testing electrochemical cell (production of hydrogen from methanol and water in the presence of KOH) and the curve labeled "H_2O" is the result obtained for the electrolysis reaction of the comparison electrochemical cell (production of hydrogen from water in the presence of KOH). The results shown in **FIG. 3** have been corrected for the Ohmic resistance of the testing cell and comparison cell.

[0073] The results for the production of hydrogen from water in the presence of KOH show that current is not produced in the comparison cell until the magnitude of the voltage is increased to about 1.4 V at 23° C. and about 1.25 V at 60° C. Absence of a current at voltage magnitudes below about 1.4 V and 1.25 V indicates that the water electrolysis reaction does not occur at those voltages at 23° C. and 60° C., respectively. Initiation of the reaction occurs at a voltage magnitude of about 1.4 V at 23° C. and about 1.25 V at 60° C. and acceleration of the reaction occurs upon further increasing the voltage magnitude above those voltages at each temperature, respectively. These results indicate that voltage magnitudes at or above 1.4 V at 23° C. and at or above 1.25 V at 60° C. are needed to produce hydrogen from the electrolysis reaction of water in the presence of KOH conducted in the comparison cell.

[0074] The results for the electrolysis reaction of methanol and water in the presence of KOH in the testing electrochemical cell show that the reaction already takes place at