Fuel cells show many advantages over storage batteries for transportation for on-board electrical power generation. Much effort is being devoted to the development of a direct methanol fuel cell (DMFC). Despite some progress, the DMFC has been plagued by low power density, which has been attributed to the low activity of the available anode catalysts. Up to now, Pt and Pt-based alloys have been commonly used anode catalysts in fuel cells based on electro-oxidation of small organic molecules, including direct methanol fuel cells (DMFCs), however they are poisoned readily by strongly adsorbed CO species, an intermediate produced in methanol electro-oxidation [1]. Therefore, based on the achievement of acceptable technical performance, the use of gold in preference to platinum could help to reduce the cost of fuel cell technology. Recently, Pt monolayer was prepared at Au (1 1 1) electrode and at roughened polycrystalline gold electrode by using upd systems for gold electrodes [2].

In this work, gold single crystal electrodes [Au(1 1 1) and Au(1 0 0)] modified with a variety of metal ad-layers were prepared by using reported upd systems for gold electrodes, namely gold surfaces modified with Cu, Zn, Ag, Pt, and Cd ad-atoms. For these metal ad-layer modified electrodes, catalytic activities towards methanol oxidation were compared to each other, and a possible reason for the excellent catalytic behavior observed on the Pt ad-layer modified Au electrode has been proposed. Pt-UPD was prepared on the gold single crystal electrode by replacement of Cu-UPD monolayer (1/3 and 1/15 ML). This procedure was applied that the surface of Au was modified by Cu-UPD, and then the Cu-UPD was replaced by Pt. The electrocatalytic properties of Pt overlayer deposited on Au for methanol electro-oxidation have been investigated by cyclic voltammetry (CV). Cyclic voltammograms of methanol was recorded by replacement 15, 30, 60 s via immersed to solution 0.1 mM K$_2$PtCl$_4$ of different monolayer Cu-UPD electrodes. These results suggest that the Pt ad-layer modified Au single crystal electrodes are allowed the oxidation of methanol at more negative potentials than at bare Au electrodes.

References