In-situ study of aluminum repassivation by using scanning droplet cell combined with quartz tip

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The aim of the research is to reveal repassivation kinetics of aluminum after a scratch or an indent of the surface in real time. The new electrochemical technique, Scanning Droplet Cell (SDC) combined with a quartz tip was used in this experiment. The basic idea of SDC is to position a small droplet of electrolyte on the surface. The wetted area acts as working electrode and the droplet cell contains counter and reference electrode. The free droplet of electrolyte is formed between capillary and aluminum surface and held by surface tension. For an effective investigation a Physik Instrumente x-y-z stage and a two axes tilting stage were used. They were driven by a DC motor controller with one encorder for each dimension.

The diameter of capillary tip used was in the range of 100 µm. The specimen surface was prepared by mechanical polishing and electropolishing to obtain mirror-like surface. A silver/silver chloride micro-reference electrode[1] and a platinum wire as counter electrode were used. The aluminium surface wetted by droplet of pH6 acetate solution and polarized at 2V. (HESS) for 100 seconds to passivated. The scratch or indentation was performed during polarization time the current transient was monitored in-situ.

A quartz rod with a diameter of about 60 µm built in a capillary was employed to indent. Scratching were performed by moving the sample. The force applied for indentation was 10-20 mN.

Fig.2 shows current transients prior to and after indentaion.After indentation, the repassivation occurred The decay of current is very smooth when compared with the scratching. The repassivation of defected area completed in the range of 400 ms

Fig.3 shows a current transient during scratching. After scratching, anodic current jumped rapidly and decreased, suggesting repassivation of defected area occurred.

The results of the indentation and scratching experimetns are linked to ex-situ investigations after mechanical attack. SEM images show the plastic deformation at various loads.

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Reference

[1] A.W. Hassel, K.Fushimi, M.Seo, Electrochem. Comm. 1 (1999) 180.

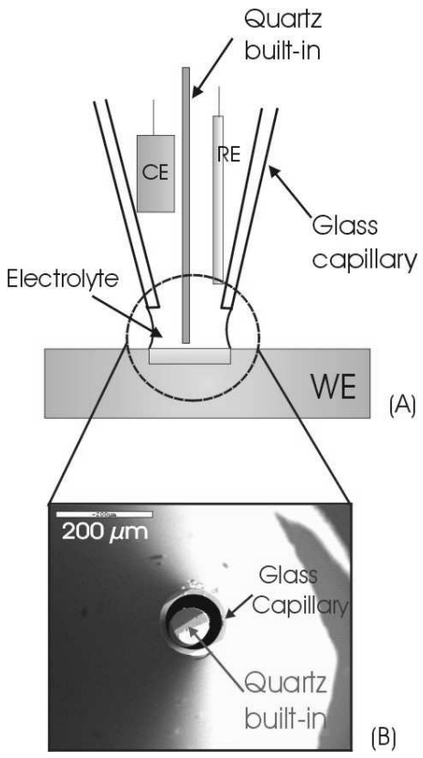

Fig 1.(A) Schematic of Scanning Droplet Cell used in the experiment.(B) SEM micrograph of grinded quartz tip built-in capillary

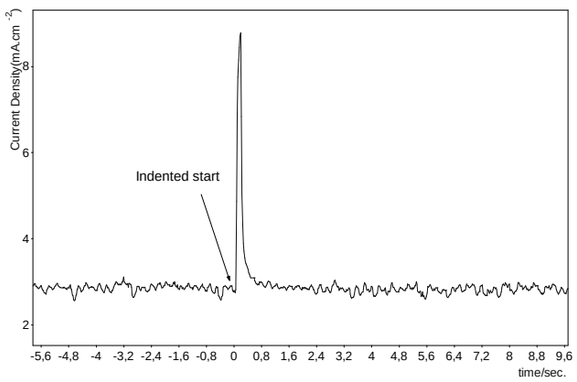

Fig. 2 Current transient of indent which provide by quartz tip built-in capillary with applied force 14 mN.

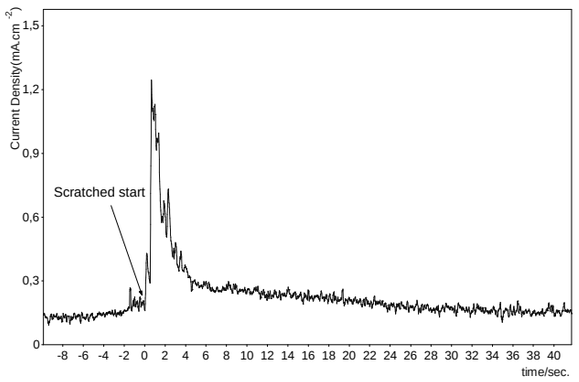

Fig. 3 Current transient of scratch which performed by moving the specimen and scratched with quartz built in capillary.