

Kinematic Study on the Passivation and Dissolution of Tungsten Surface during Tungsten CMP Process

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The passivation and dissolution reactions during metal CMP process are the most important and basic electrochemical reactions for proper progress of metal CMP. These reactions are normally governed by the chemical condition of CMP slurry such as kinds of oxidants, complexing agents and pH.^{1,2)}

In this study, passivation and dissolution kinetics of tungsten/tungsten-oxide in CMP slurry with two different oxidants, hydrogen peroxide and ferric nitrate, were investigated by using the potentiodynamic scanning (Fig.1) and cyclic voltammetric methods (Fig.2). Moreover, microstructure and the temporal variation of the chemical state of surface layer were also examined by scanning electron microscope and X-ray photoelectron spectroscopy.

According to the analysis, CMP slurry containing ferric nitrate showed strong and stable passivation effect on tungsten surface, whereas hydrogen peroxide could not because hydrogen peroxide instantly induced the post-dissolution of produced passivation layer. Such different electrochemical responses of tungsten surface with respect to the oxidant conditions induced very different microstructure and chemical state of tungsten surface, resulting in different CMP characteristics.

References

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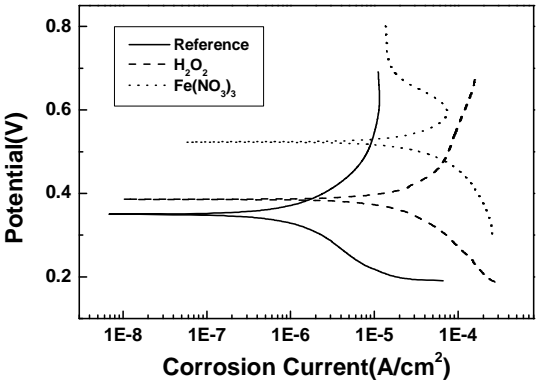


Fig. 1. Potentiodynamic polarization curves of tungsten in CMP slurry with different oxidant conditions.

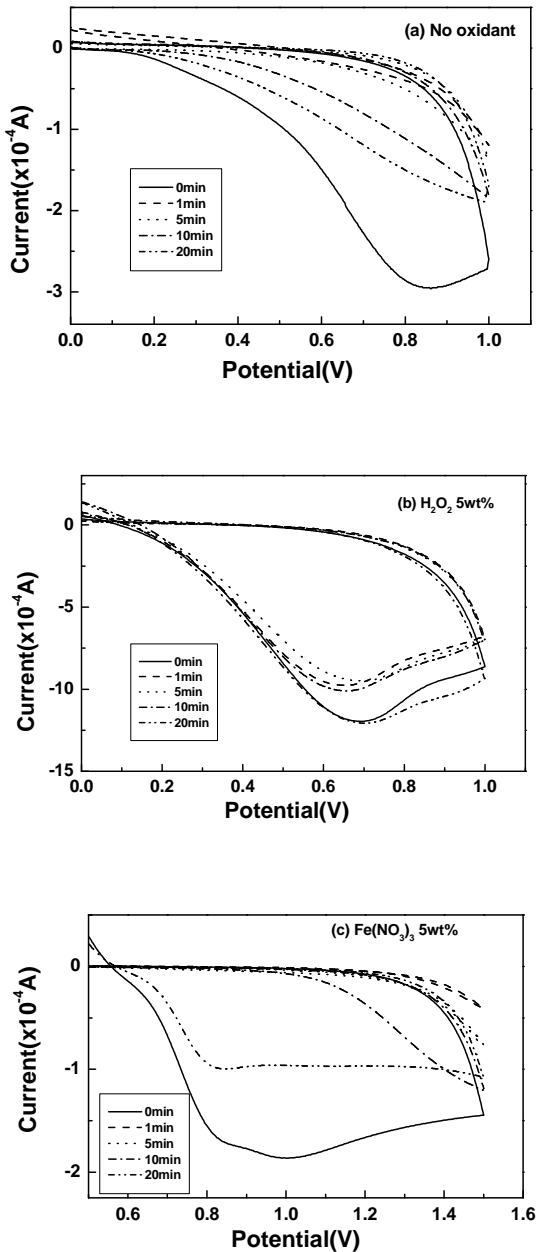


Fig. 2. Temporal variations of the cyclic voltammograms of tungsten in CMP slurry containing (a) no oxidant, (b) H₂O₂ 5wt%, (c) Fe(NO₃)₃ 5wt%.