Formation of dual components monolayers on galvanic gold substrate

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Gold is a noble metal that is used as corrosion protecting coating for electronic applications such as connectors. But, this gold layer is damaged by wear and the underneath metal (generally a copper based alloy) can be oxidized. This implies an increase of the contact resistance and the connector has to be replaced. Up to now, a film of lubricant is deposited on the connectors in order to decrease the friction and thus protect the gold layer. But as gold, insertion-desinsertion cycles and vibration cause a displacement of the lubricant layer and wear of gold finally occur.

Our approach of this problem consist to form a layer as retention promoter of the lubricant. Self-assembled monolayers (SAMs) of alkanethiol are very interesting candidate : these are chemically grafted layer with a controllable structure [1, 2]. A second advantage is the corrosion protection properties of SAMs [3] that act as a barrier against corroding species. In this work, SAMs composed of two molecules has been formed. These molecules are partially fluorinated alkanethiol and dithiol functionalised PFPE. Both molecules have a particular role : the partially fluorinated alkanethiol is used for obtaining a more compact monolayer and the dithiol PFPE allows to have a great interaction with the lubricant. By the difference in length of these two molecules, it is expected to promote the lubricant retaining.

The monolayers have been prepared by dipping the galvanic gold in a solution for a very short time. Two processes are compared : one step : modification in a solution containing a mixture of both molecules and two steps : modification in two successive solutions of each molecules. These monolayers have been studied by X-ray photoelectron spectroscopy (XPS) and electrochemical technique (cyclic voltametry and electrochemical impedance spectroscopy). A lubricant film have been deposited on the monolayers self- assembled on evaporated gold and the wetting has been observed by optical microscopy.

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References

[1] LAIBINIS P.E., WHITESIDES G.M., ALLARA D.L., TAO Y.-T., PARIKH A.N., NUZZO R.G., J. Am. Chem. Soc. 113 (1991) 7152

[2] (a) TSAO M.-W., HOFFMAN, C.L., RABOLT J.F., Langmuir 13 (1997) 4317, (b) TAMADA K., ISHIDA T., KNOLL W., FUKUSHIMA H., COLODARO R., GRAUPE Jr.,M., SHMAKOVA O.E., LEE T.R., Langmuir 17 (2001) 1913

[3] (a) LAIBINIS P.E., WHITESIDES G.M., J. Am. Chem. Soc. 114 (1992) 9022, (b) HANEDA R., NISHIHARA H.,MAKI K., J. Electrochem. Soc. 144 (1997) 1215