

Confined electrodeposition of metals and semiconductors

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The crucial point in material electrodeposition is to control the dimension of the electrodeposited structures. Miniaturization is necessary not only for computers but also in the electronic and optoelectronic industries, and, more generally, for the realization of new functional and smart materials. The great interest in nanometer-scale materials stems from the fact that their optical, electrical, magnetic or mechanical properties are often very different from the same materials in the bulk phase, and, which is more important, they can be tuned by changing the physical dimensions of the material.

This work is directed to the realization of templates for the electrodeposition of nanometric or submicrometric materials. More particularly, templates were obtained by selectively desorbing a thiol from a SAM formed by a mixture of thiols on Ag(111). In fact, the desorption potential is the more negative the more long is the alkane chain. Therefore, applying a suitable potential allows the desorption of the shorter thiol chain.

Self-assembled monolayers composed of two different alkanethiols having different chain lengths exhibit phase separation at nanometer scale on Au and Ag surfaces¹. The selective desorption of one thiol at sufficiently negative potentials, leaves a domain of free electrode surface available for electrodeposition. The obtained template was checked with electrodeposition of a well known compound.

This work reports on the electrodeposition of CdS by ElectroChemical Atomic Layer Epitaxy (ECALE) in the free areas of Ag(111) as obtained by the selective desorption of 3-mercapto-1-propanol (MPA) from mixtures with *n*-alkanethiols with *n* equal to 8 and 12. The comparison with the amount of compound deposited on a bare Ag(111) shows that the free surface available for electrodeposition after the selective desorption coincides with the amount of the thiol desorbed.

The procedure can be extended to the deposition of metals with the aim of limiting the amount of precious metals in electrocatalysis.

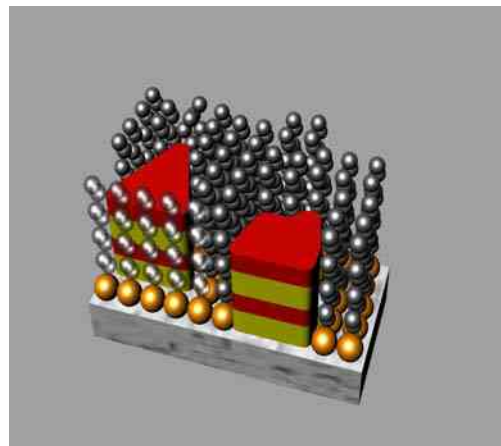


Fig. 1 schematizes the electrodeposition of CdS between a SAM of thiols.

1. Hobara, D.; Kakiuchi, T.; *Electrochemistry Communications* 2001, 3, 154-157.