Reactivity of Iron Sulfide Layers on Au(111)

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The idea at the basis of the origin-of-life theory of G. Wächtershäuser [1] relies on the activation of carbon dioxide on iron sulphide to form simple organic molecules. Both theoretical and experimental results indicate the mineral greigite (Fe_3S_4) as a possible active material for this purpose [2]. We found a way to produce well-ordered iron sulphide layers by deposition of Fe in a reactive S_2 atmosphere on an Au(111) substrate. In order to avoid a sulphur contamination of the experimental chamber, the preparation is performed in a dedicated chamber. By following this procedure, it is possible to obtain a sulphur-terminated layer with a homogeneous, well-ordered surface with hexagonal symmetry (as seen by XPS and STM, respectively). The same symmetry is seen in the LEED pattern, with a lattice parameter compatible with that of Fe_3S_4(111). However, the iron contained in the sulphide layer is found to easily alloy with the gold in the substrate, which leads to a sulphur-rich overlayer with little reactivity to CO_2. With the idea of better isolating the sulphide layer, we managed to grow an iron oxide (FeO) buffer layer that prevents this kind of alloying. This will possibly pave the way to an understoichiometric sulphide, which, according to some recent theoretical analysis [3], would be better suited for the activation of CO_2.

References:
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