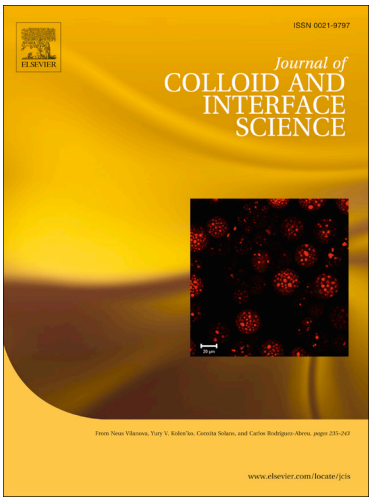

Metal–organic frameworks derived tin-doped cobalt oxideyolk-shell nanostructures and their gas sensing properties

Lanlan Guo, Fang Chen, Ning Xie, Chong Wang, Xueying Kou, Yanfeng Sun, Jian Ma, Xishuang Liang, Yuan Gao, Geyu Lu

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Surface Chemistry of Thermal Dry Etching of Cobalt Thin Films Using Hexafluoroacetylacetone (hfacH)

Jing Zhao,[1,&] Mahsa Konh,[1,&] Andrew Teplyakov[1*]

1. *University of Delaware, Department of Chemistry and Biochemistry, Newark, DE, USA.*

Abstract:

A mechanism of thermal dry etching process of cobalt thin films by using 1,1,1,5,5,5-hexafluoro-2,4-pentanedione (hexafluoroacetylacetone, hfacH) was investigated. This process, relevant to atomic layer etching (ALE) technology directed towards oxidized cobalt films, requires adsorption of molecular organic precursor, such as hfacH, at moderate temperatures and is often thought of as releasing water and $Co(hfac)_2$ at elevated temperatures. The reaction was analyzed in situ by temperature-programmed desorption (TPD) and the resulting surface was investigated ex situ by X-ray photoelectron spectroscopy (XPS). The changes in surface morphology during the process were monitored by atomic force microscopy (AFM) and scanning electron microscopy (SEM). The removal of $Co(hfac)_2$ from the surface was observed above 650 K, a temperature well above commercially desired etching conditions, suggesting that the thermal etching process is more complex than originally envisioned. In addition, the upper limit of thermal treatment is established at 800 K, as the microscopic techniques clearly indicated surface morphology changes above this temperature. In addition, the structure of the surface at the nanoscale is observed to be affected by the presence of surface bound organic ligands even at room temperature. Thus, further mechanistic studies should address the kinetic regime and surface morphology to make inroads into mechanistic understanding of the dry etching process.

Keywords:
Dry etching, cobalt thin films, reaction mechanism

* Corresponding author: Department of Chemistry and Biochemistry, University of Delaware,