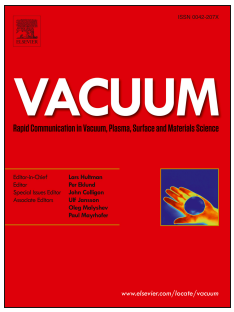
Accepted Manuscript



Carbon copper thin films for discoloration of indigo carmine

Anthony Lelong, Akram Sakli, Andreas Zeinert, Michael Lejeune

PII: S0042-207X(17)31063-1

DOI: 10.1016/j.vacuum.2017.11.010

Reference: VAC 7678

To appear in: *Vacuum*

Received Date: 9 August 2017

Revised Date: 6 November 2017

Accepted Date: 7 November 2017

Please cite this article as: Lelong A, Sakli A, Zeinert A, Lejeune M, Carbon copper thin films for discoloration of indigo carmine, *Vacuum* (2017), doi: 10.1016/j.vacuum.2017.11.010.

Carbon copper thin films for discoloration of indigo carmine

Anthony Lelong[a], Akram Sakli[a], Andreas Zeinert[a], Michael Lejeune[a]*

[a] Laboratoire de Physique de la Matière Condensée (LPMC), EA 2081, 80039 Amiens Cedex, France

Corresponding author *: michael.lejeune@u-picardie.fr

Abstract:

Copper-C_XH_Y composites were elaborated by RF magnetron sputtering of a pure copper target in a reactive gas mixture of argon (Ar) and cyclohexane. Some structural and optical characterization have been performed revealing the presence of nanometric Cu/Cu_2O/CuO particles embedded into a disordered hydrogenated carbon matrix. The optical measurements have shown the properties of a semiconductor material with an indirect gap and a direct transition in the visible range. Catalytic effect of the copper-C_XH_Y composites has been tested by monitoring the degradation of a dye (the indigo carmine) in a water solution induced by the light.

Keywords:
Hybrid materials
carbon based materials
optical properties
catalytic effect
discoloration

Main text:

Environmental pollution caused by human activity has become a major issue for this century. In particular, water and air pollution require a better management of both the pollutant emission and the resources consumption combined with efficient remediation techniques of already polluted milieus. The latter is crucial because the tools used for the remediation have to be “green” and not energy-greedy. Therefore, the research is turning towards advanced oxidation processes such as, for example, ozonation, fenton reactions or photocatalysis **[1-3]**. Photocatalysis (PC) is an interesting approach because of its low energy need and the possibility to treat pollutants in liquid or gaseous form.

Photocatalysis is exploited in semiconductor materials mainly in the form of particles such as the metallic oxides: TiO_2 and ZnO **[4,5]**. Most of the currently used PC materials are activated by ultraviolet light and after remediation the residual products need filtering in order to recover the nanoparticles. As the solar spectrum has a maximum of irradiation in the visible, a PC material with optical absorption in this range could be an interesting candidate. The use of composite materials (nanoparticles embedded into a matrix) could overcome the problem of separation between catalyst and medium **[6]**. For that reason, we have chosen, in this work, to study the properties of nano-composite thin films: copper (Cu) particles embedded into a hydrogenated carbon based matrix. Carbon materials are well known for their chemical **[7]** and good mechanical properties. For the nanoparticles, Cu seems a good candidate. First of all, Cu and its complexes such as Cu oxides are known for their catalytic properties **[8]**. Cu also shows both oxidation properties by dehydrogenation of alcohol and reductive properties for hydrogenation reactions **[9,10]**. Moreover, Cu is used for its optical properties in plasmonic photocatalysis **[11]**. Recently, an article about Cu particles immobilized on a silicon oxide has demonstrated photocatalytic antibacterial properties when it is irradiated by a mercury lamp **[12]**. This communication outlines the elaboration of a carbon-copper nano-composite thin film by a single step method (sputtering of a copper target by a reactive plasma) **[13]**, and its structural characterization. Additionally, some photocatalysis