

Low temperature plasma deoxidation of copper surfaces

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Metals are commonly contaminated with surface oxide layers, which limit the performance of materials in different industrial applications like coating or welding. Therefore, implementation of a technique, which can provide a deoxidation effect to a metal surface without a morphology modification, is of a big interest. Nowadays, low temperature hydrogen plasmas are shown to be effective in the metal surface deoxidation processes. Large number of studies have been focused on the development of hydrogen plasma deoxidation techniques, which operate at low pressures below 1 hPa. Such methods usually needed long times for deoxidation as well as worked in a combination with additional heating, which generally raises the costs of techniques. In contrast, only few groups have investigated the metal deoxidation effect of low temperature plasmas that operate in the atmospheric pressure range at room temperature. Promising results of deoxidation performance were shown for dielectric barrier discharge (DBD) plasmas. The relative simplicity of the plasma setup, the possibility of operating at atmospheric pressure as well as the lack of studies and additional information about the deoxidation effect motivate this work on DBD plasma deoxidation.

In this study, the application of a DBD plasma for metal deoxidation was shown on differently oxidized copper surfaces in an Ar/H₂ atmosphere at 100 hPa and room temperature. Plasma treatments with a discharge voltage of 11 kV and a frequency of 8.8 kHz yielded an almost complete deoxidation of samples with native Cu₂O layers and samples with pre-oxidized CuO layers, both within minutes of the Ar/H₂ plasma treatment. The chemical state of the samples was characterized via X-ray photoelectron spectroscopy (XPS). The plasma was analysed by optical emission spectroscopy (OES). Additionally, confocal laser scanning microscopy (CLSM) images show that the employed deoxidation method did not change the morphology of the copper surfaces.