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Surface characterization of copper substrates modified with carboxyl terminated phosphonic acids

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ABSTRACT

The surface modification of copper substrates by means of liquid phase reaction with 1H, 1H, 2H, 2H-perfluorooctanephosphonic acid, 6-phosphonohexanoic acid and 16-phosphonohexadecanoic acid is investigated. The substrate preparation is based on common industrial methods and avoids a separate oxidation step of the copper surface prior to modification. Analysis and characterization of the surfaces were performed using various physico-chemical methods. The film formation of a fluoroalkyl phosphonic acid and two carboxyl terminated phosphonic acids on the copper surface was proven by X-ray photoelectron spectroscopy, infrared spectroscopy, SEM/EDX as well as water contact angle measurements. For 16-phosphonohexadecanoic acid a higher film thickness was obtained compared to 6-phosphonohexanoic acid. Hydrogen bonds between adjacent carboxylic terminated phosphonic acids lead to multilayer formation. In additional experiments, these phosphonic acids were investigated as adhesion promoters in copper / epoxy resin laminates in order to replace conventional surface roughening processes. For these laminates, the peel strength was significantly higher when the copper surface was functionalized with 16-phosphonohexadecanoic acid.

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