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Synthesis of carbon xerogels modified with amine groups and copper for efficient adsorption of caffeine

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Abstract

Carbon xerogels studied were synthesized by two methods. The first was based on polycondensation of resorcinol and formaldehyde.The material obtained in this way was subjected to surface oxidation and modification with amine groups followed by impregnation with copper(II) chloride. In the second method copper(II) acetate was introduced at the stage of condensation of resorcinol and formaldehyde. The sample was additionally functionalized with amine groups whose source was ethylenediamine. The carbon xerogels were characterized by low-temperature nitrogen adsorption, X-ray diffraction, elemental analysis and inductively coupled plasma mass spectrometry. The content of oxygen functional groups on the surface of the materials obtained was determined by the Boehm method. The xerogel samples obtained were applied for adsorption of caffeine from water solutions. The maximum sorption capacities of the samples were in the range 91 – 118 mg/g. The most effective adsorbent of caffeine was the sample modified with copper(II) acetate and amine groups. Acidic environment was found conducive to caffeine adsorption, while with increasing temperature the sorption capacities of the carbon xerogels towards caffeine decreased. The sorption of caffeine was spontaneous in character and endothermic. Interpretation of the isotherms of caffeine adsorption on the surface of the xerogels studied was carried out with the use of two models of Langmuir and Freundlich, the former was more suitable for description of the process.