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Thermochemical Methods for the Characterization of the Organosilicas with Immobilized Aminophosphonic Acid

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Influence of grafted group structure onto the thermal stability was studied for aminoalkylphosphonic acids grafted on SiO_2 (SiO_2-APA) by means of thermal analysis (TA), differential scanning calorimetry and temperature-programmed desorption mass-spectrometry (TPD-MS). Four samples of silica with covalently attached alkylaminophosphonic acids (APA) having various complexing fragments were selected for the investigation. According TA greatest weight loss is observed at t = 250-400 °C for the samples with bulky radicals in α-carbon atom of the grafted molecule. Thermal stability of unsubstituted aminophosphonic acids is significantly higher compared to the other APA studied. From TPDMS data it was demonstrated that during the thermal decomposition of APA-SiO_2 immobilized phosphonic acid reacts with the silanol group of SiO_2. As the result phosphorus moieties are absent in the mass spectra of samples during their thermal desorption. Aminodiphosphonic acid decomposes over a wide temperature range (300-700 °C) to form a mixture of low molecular weight products (mainly C_1-C_3 hydrocarbons and ammonia). Substituted monophosphonic acids (2-hydroxybenzyl and 3-pyridyl) decompose with two distinct endothermic processes at 250-400 °C accompanied by the desorption of aromatic fragments followed by a high-temperature (450-600 °C) process of aminopropyl spacer decomposition.

Keywords: modified silicas, aminophosphonates, TPDMS, thermal stability