Investigation of carbon-metal containing tubules influence on foam cokes structure

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Epoxy resin ED-20 containing ammonium polyphospate (APP), phenanthrene dehydropolycondensation product containing chromium (PA-Cr), nickel (Pa-Ni), manganese (PA-Mn), calcium borate and/or manganese oxide was used to investigate the influence of carbon-metal containing tubules on the structure of foam cokes modified with intumescent systems of epoxy resin. It is found out that in the process of dehydropolycondensation and stimulated carbonization of phenanthrene in the presence of chromium salts cylindrical micro and nanostructures (tubules) are formed. Epoxy resin was hardened with polyethylene-polyamine.

X-ray photoelectron method (XPS) was used to investigate the surface and boundary layers (layers chips) of hardened epoxy resin and pyrolysis remains. When the sample is heated up to the temperature at which pyrolysis starts (260 ^{0}C) the egress of the sample of phosphorus-containing groups is observed. This is proved by phosphorus concentration increase on the surface as well as the intensity redistribution of 1s line of nitrogen, carbon and oxygen in X-ray photoelectron spectrum. When the temperature goes up in boundary layers, the relative number of C-OR and carboxyl groups decreases showing the carbonized layer growth. (ris. 1).

In comparison with the results obtained the introduction of nickel-containing tubules into the composition with the ratio of APP and NiT – 10:1 leads to the increase of carbon-carbon and carbon-metal groups in practically 3 times (ris. 2).

The topography of inner and outer layers of foam cokes formed was investigated with atom force microscopy. The differences in the topography of samples investigated as well as in the topography of inner and outer layers of one and the same foam coke were observed. At the same time it was found out that root-mean-square roughness R_q, foam coke structure of inner and outer surfaces, location and shape of the bubbles depend on the metal contained in the tubule. While investigating the strength of inner and outer surfaces it was determined that they have different values depending on the tubule applied.

When the temperature dependence of heat capacity of intumescent compositions was investigated, it was found that the heat capacity increases together with the temperature growth and reaches its maximum at 150 ^{0}C and 300 ^{0}C. The temperature dependence of heat conductivity of intumescent composition surface correlates with the analogous heat capacity dependence. The availability of extremes is explained by physical-chemical processes proceeding during the foam coke formation as well as by its structure and strength characteristics.

Thus, based on the results shown it can be asserted that calcium borate and metal containing tubules are effective structure-forming agents in foam-coke formation process. It can be also assumed that the introduction of metal containing tubules influences the structure changes of stimulator and gas-former together with the influence on hardening polymer structure thus facilitating the formation of foam cokes of certain structure and surface composition.

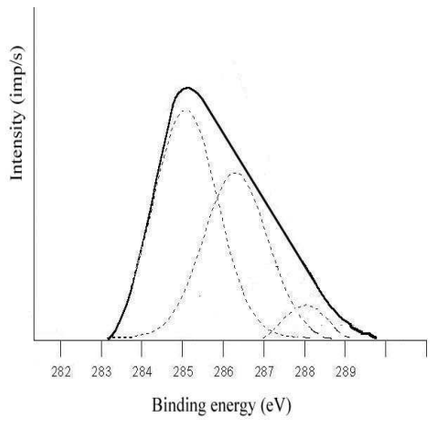

Fig. 1

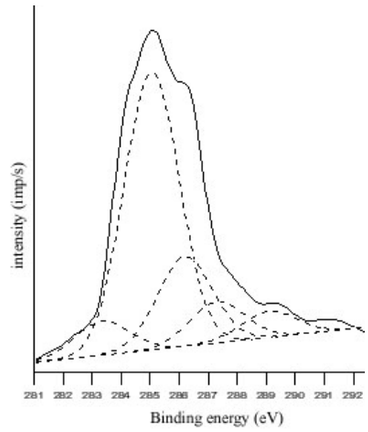

Fig. 2