SURFACE PROPERTIES OF POLYMER-COATED HMX PARTICLES BY SCANNING PROBE MICROSCOPY

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Abstract: The HMX particles coated with polymethyl acrylate (PMA), ethyl cellulose (EC), and perfluoropolymer (PFP) are studied using various methods of scanning probe microscopy. The goal is to understand the reasons of the detected changes of macroscopic properties, i. e., decrease in the impact sensitivity and the improvement in flowability of the coated HMX particles. For composites with PMA and EC, it is found that the surface roughness increases with the precipitation of the polymer in amount of 1–3 %(mass.) as compared to the untreated particles. Apparently, "precipitating" of the polymer under conditions of antisolution by supercritical CO_2 leads to the localization of polymer globules on the surface, thus not forming a continuous polymer layer as would be expected, and causes a decrease in sensitivity to mechanical stimuli. Measurement of the adhesion forces shows that with an increase in the polymer content, the adhesion force also rises, thus the amount of polymer globules located on the particles begins to grow. The electric potential on the surface of the particles is significantly reduced by increasing the content of EC and PMA, and for the PFP, on the contrary, rises. The differences found are likely to cause a significant increase in the flowability of HMX particles coated with EC and PMA polymers.

Keywords: atomic-force microscopy (AFM); scanning probe microscopy (SPM); HMX; polymer coating; flowability; sensitivity to mechanical stimuli

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Figure Captions

Figure 1 Topography of HMX/PMA composite: image size 30×30 μm (*a*) and 2×2 μm (*b*)

Figure 2 Surface roughness as a function of polymer concentration for HMX/polymer composites: *1* — PFP; *2* — EC; and *3* — PMA

Figure 3 Adhesion force as a function of polymer concentration for HMX/polymer composites

Figure 4 Surface potential variation as a function of polymer concentration measured on the surface of single HMX/polymer particle: *1* — PFP; *2* — EC; and *3* — PMA

Figure 5 Surface potential distribution for HMX/EC (*a*) and for HMX/PFP composites (*b*)

Table Captions

Table 1 Literature data on impact sensitivity of HMX/polymer composites

Table 2 Adhesion force for pure HMX and polymers

Table 3 Impact E_{50} and friction F_{50} sensitivities, local adhesion force F_a, and time t of powder to flow through the funnel for HMX/polymer composites

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