

THE UNIFIED COMBUSTION MECHANISM OF ENERGETIC MATERIALS

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Abstract: The effect of 1'-diethylferrocene (DEF) individually and in combination with carbon black (CB) and carbon nanotubes (CNT) on the combustion of a model sample based on an inactive binder 12.2% polyvinyl butyral, plasticized with 15.8% dibutyl phthalate and 70% ammonium perchlorate containing 1.4% teflon-4 and 0.6% technological additives was studied. Propellants samples were manufactured using rolling and through-pressing. Burning rate was determined in a constant pressure device in a nitrogen atmosphere on armored checkers with a diameter of 6 mm and a height of 15 mm. The structure and elemental composition of the combustion surface of the quenched samples are investigated. It was shown that when samples with a catalyst and CNT are burned, a frame is formed on the combustion surface on which a significant accumulation of the catalyst particles, CNT, and teflon occurs. Thus, combustion catalysis occurs by the same mechanism as for double-based propellants and various explosives containing nitrogroups, i. e., the mechanism of catalysis of energetic materials is uniform.

Keywords: combustion catalysis; energetic materials; carbon frame

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Figure Captions

Figure 1 Burning rate dependence on pressure of samples with 2% DEF in combination with carbon black and various amounts of CNTs: 1 — base sample (empty signs — diameter 10.5 mm); 2 — 3% CB; 3 — 1% CNT; 4 — without CNT; 5 — 2% CNT; and 6 — 3% CNT

Figure 2 The effect of 3% CB and various amounts of CNTs on the effectiveness of 2% DEF: 1 — 3% soot; 2 — 1% CNT; 3 — without CNT; 4 — 2% CNT; and 5 — 3% CNT

Figure 3 Burning rate dependence on pressure of samples with different amount of CNTs: 1 — base sample; 2 — 1% CNT; 3 — 2% CNT; 4 — 3% CNT; 5 — 4% CNT; and 6 — 5% CNT

Figure 4 The effect of the amount of CNTs (without DEF) on the Z value at different pressures: 1 — 5% CB; 2 — 3% CB; 3 — 1% CNT; 4 — 2% CNT; 5 — 3% CNT; 6 — 4% CNT; and 7 — 5% CNT

Figure 5 Dependence of the effectiveness of CNTs on their content at different pressures: 1 — 3 MPa; 2 — 5; 3 — 10; and 4 — 15 MPa

Figure 6 Structure of combustion surface of quenched samples: (a) without additives (3 MPa); (b) with 5% CNT (3 MPa); (c) with 2% DEF (1 MPa); and (d) with 2% DEF + 3% CNT (1 MPa)

Table Captions

Table 1 The effect of CNT and CB on the effectiveness of 2% DEF on the combustion rate of the model sample

Table 2 The effect of different amounts of CNTs on the burning rate of the sample

Table 3 Elemental composition of the combustion surface of quenched propellant samples

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