Mechanical Behavior and Energy Release in PTFE/Al Composites Enhanced with Ammonium Perchlorate Micro-Particles

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Abstract

Reactive materials have gained significant attention as energetic materials, particularly in shielding applications. One notable example is the Polytetrafluoroethylene (PTFE)/Aluminum (Al) composite, which exhibits significant energy release when subjected to high-velocity impacts or extreme strain rates, along with notable mechanical properties. This study investigates the influence of Ammonium Perchlorate (AP) micro-particles on the mechanical performance and energy release capabilities of PTFE/Al mixtures through experimental approaches. Four sets of samples, with 0%, 1%, 2%, and 3% AP content, were subjected to calorimetric bomb testing. The results demonstrated a 13% increase in the calorific power of PTFE/Al with the incorporation of 3% AP, suggesting its potential as an improved reactive material. Scanning electron microscope (SEM) analysis revealed a homogeneous and fibrous structure in the sintered PTFE/Al/GO composite, with a uniform coating of Al and AP particles by PTFE. Compression tests highlighted a transition from ductile behavior in the sample without AP to increased stiffness and toughness with higher AP content. Furthermore, high-velocity impact testing using a split Hopkinson pressure bar (SHPB) demonstrated enhanced energy absorption and elasto-plastic behavior with increasing AP levels. Overall, this study provides novel insights into the integration of AP into PTFE/Al composites, showcasing enhanced reactivity and mechanical properties.

Keywords:
Reactive materials; PTFE/Al composite; SHPB; Mechanical properties; Energy release.

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