DPD Simulations on the Effect of Nanoparticle Shapes, Sizes, Contents and Gradations on the Viscosity of Energetic Suspensions

ZHOU Yang[1], **LI Yi-xue**[2], **QIAN Wen**[1], **HE Bi**[1]
(1. *Institute of Chemical Materials*, *CAEP*, *Mianyang* 621999, *China*; 2. *Graduate School*, *CAEP*, *Mianyang* 621999, *China*)

Abstract: Controlling the fluid behaviors of energetic suspensions is one of the crucial technologies for controlling the inner defects of munitions. Considering the lack work on energetic suspensions with nanoparticles, dissipative particle dynamics(DPD) simulation technology was used to investigate the influences of particle shape, size, content and gradation on the viscosity of energetic suspension systems in this paper. It shows that the influence of the particle shape can be neglected in the case of low contents. With the increase of the content of nanoparticles, the viscosity of the suspension rises accordingly. For a same amount of nanoparticles, the smaller the size, the greater the viscosity of the suspension. The addition of nanoparticles does not change the dependence of the system viscosity on the temperature. For the same content, the particle gradation of two different sizes of nanoparticles can effectively adjust the viscosity of the system. By introducing the solvation effect of nanoparticles, the traditional Einstein viscosity calculation formula is corrected to be more efficient. The particle size and content are both introduced to a model to effectively predict the viscosity of fluids ranging from nano- to micro-scale.

Key words: energetic suspension; nanoparticles; viscosity; dissipative particle dynamics(DPD)
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读者·作者·编者

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含能材料的损伤特征与点火过程有密切的联系，炸药、推进剂的内部损伤及其对力学特性、安全特性和点火行为的影响规律受到了含能材料学界的高度重视，为推动这一重要研究方向的学术交流，本刊特设立“损伤与点火”专栏。专栏主要征集炸药、推进剂等含能材料的损伤观测与多尺度表征技术、含损伤的本构方程、准静态与动态损伤演化规律、损伤与破坏的宏(细)观模式、损伤对起爆、爆炸、爆轰成长以及非冲击起爆行为的影响等方向的原创性研究论文。来稿请注明“损伤与点火”专栏。

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