Direct Writing Deposition Rule of CL-20 Based Explosive Ink

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Abstract: Direct writing technology has the advantages of safety, batch and precise graphics, and it is the trend of future development of precision and efficient charge forming for energetic micro devices. Based on hexanitrohexaazaisowurtzitane (CL-20) based explosive ink, the effect of driving pressure and outlet diameter on the extrusion rate was investigated by the combination method of the simulation using Ansys software and the direct writing deposition experiment. The direct writing deposition data were analyzed by Matlab software. The effective direct wring parameters were obtained by an interpolation analysis method. The mathematical model describing the direct writing deposition rule was established. Results show the prepared CL-20 based explosive ink is a non-Newtonian fluid with a viscosity range of 10 Pa·s to 350 Pa·s. When the shear stress is greater than 650 Pa, the loss modulus is larger than storage modulus gradually. When the driving pressure is greater than 350 kPa, the viscosity of the CL-20 baded explosive ink decreases, making the change rate of the extrusion rate increase. When the outlet diameter is bigger than 0.6 mm, decreasing the extrusion energy loss of the ink decreases makes the change rate of the extrusion rate increase. The established direct writing parameters relation formula is $u_1 = 0.00047 \times d_1^{0.6516} \times p^{1.5291}$, which indicates that the driving pressure is greater than the effect of outlet diameter on the extrusion rate.

Key words: hexanitrohexaazaisowurtzitane(CL-20); explosive ink; deposition rule; numerical simulation

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