Additive manufacturing of personalized medicine: Comparison of linear, 4-arm star, and graft poly(vinyl pyrrolidone) as polymeric binders for binder jetting

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Fabrication of personalized dosage oral pharmaceuticals using additive manufacturing (AM) provides patients with customizable, locally manufactured, and cost-efficient tablets, while reducing the probability of side-effects. The selection of polymeric binders is also limited due to viscosity restraints, which limits molecular weight and concentration. To investigate and ameliorate these limitations, this work reports a comprehensive study of linear and 4-arm star poly(vinyl pyrrolidone) (PVP) over a range of molecular weights as polymeric binders for binder jetting additive manufacturing, and their effect on physical tablet properties. Formulation of varying molecular weights and concentrations of linear and 4-arm star PVP in DI water and subsequent jetting revealed relationships between the critical overlap concentrations (C*) and jettability on binder jetting systems with thermal inkjet systems. After printing with a commercially available ZCorp Spectrum Z510 printer with a HP11 printhead with a lactose and powdered sugar powder bed, subsequent measurement of compressive strength, compressive modulus, and porosity revealed structure-property relationships between molecular weight, polymer concentration, and linear and 4-arm star architectures with physical properties of binder jetted tablets. This study indicated that the dominating factor to increase compressive strength of a tablet is the weight percent polymer in the binder, which filled interstitial voids between powder particles.