

Cubic magnetically guided nano-aggregates for inhalable anticancer drug delivery: Pulmonary deposition

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The present work describes the pulmonary deposition and enhanced deaggregation behavior of multifunctional magnetic nano-aggregates. Magnetic dry powders for inhalation loaded with iron oxide nanoparticles were surface functionalized with variable concentrations of block copolymer, PPG-NH₂. Increasing the concentration of PPG-NH₂ showed controlled manipulation of the crystal size and morphology. Magnetic nanoparticles fabricated with 5 weight % of PPG-NH₂ showed cubic crystal morphology. However, these nanoparticles exhibited rhombic dodecahedron crystal structure upon increasing the concentration to 25 weight %. Cubic phase magnetic nanoparticles demonstrated an enhanced in vitro aerosol deposition using magnetic field alignment. This enhancement can be accomplished at low inhalation flow rate (15 LPM). However, transformation to the rhombic dodecahedron crystallographic structure was observed to be associated with reduction in the powder geometric standard deviation (GSD), especially at 15 and 30 LPM. The approach presented in this paper showed significant enhancement in the deaggregation behavior of inhalation dry powders; that can be achieved with small amounts of magnetic nano-carriers relative to the active pharmaceutical ingredient. Aggregates of cubic nanoparticles showed promise for targeted pulmonary deposition of anticancer drugs.

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