Engineering “Smart” Nanoparticles for Improved Nanomedicine.

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The development of nanoparticle carriers that enhance drug delivery while reducing harmful side effects is an area of active research. The physical and chemical properties of materials are often exploited to form nanoparticles with features including controlled drug release, improved bioavailability, high drug loading and targeted delivery. However, there are many technological challenges that must be overcome to fully realize the potential of nanoparticles in therapeutic delivery, and one major challenge is engineering effective endosomal escape. The internalization of nanoparticles often results in the entrapment of the particles inside endosomal compartments, where enzymes that can degrade the cargo reside. Therefore, to achieve effective therapeutic delivery, materials used as drug carriers need to be designed to ensure the effective release of the therapeutic from the endosomes. However, while there are many carriers that can achieve endosomal escape, there is still limited knowledge on the characteristics that are required. In this study, we have developed pH responsive nanoparticles that we can use as a “smart” model to understand this important cellular phenomena. These particles are designed using a simple nanoprecipitation of a dual component poly[2-(diethylamino)ethyl methacrylate)(PDEAEMA) and poly(ethylene glycol)-b-poly[2-(diethylamino)ethyl methacrylate) (PEG-b-PDEAEMA) mixture. These particles are of interest as they can be tailored to degrade over a wide pH range, can load a range of cargo and importantly have tunable endosomal capabilities. This modular nanoparticle offers important insights into the design of effective nanocarriers.