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Nanogels for gene delivery

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During the last decades, gene therapy has demonstrated its huge potential, attracting a growing interest from the medicinal scientific community. However, it encounters limitations due to the lack of suitable carriers to vectorize nucleic acids inside targeted cells. Nanogels are highly hydrated nano-size crosslinked polymeric networks that have been used in many biomedical applications, from drug delivery to tissue engineering and diagnostics. Due to their easy production, tunability, and swelling properties they have called the attention as promising vectors for gene delivery. Precipitation polymerization is a polymerization technique based on the difference of solubility between the monomers and the resulting growing polymers, largely reported in the preparation of nanomaterials with advanced structures. Core-shell structures can be reached playing with the monomers' solubility and with the polymerization pathway. Dendritic polyglycerol (dPG) is used as crosslinker, with N-isopropylacrylamide (NIPAM) and N-isopropylmethacrylamide (NIPMAM) as thermo-responsive monomers. Insights in the polymerization mechanism are first reported. Aiming to introduce positive charges in the core of such nanogels, two different set of nanogels are prepared from 2-dimethylaminothyl methacrylate (DMAEMA) and glycidyl methacrylate (GMA) copolymerization, with subsequent functionalization of GMA with ethylenediamine (ED) via the epoxy group. Then, the impact of DMAEMA and GMA copolymerization on the final structure using both batch and semi-batch pathways is investigated. Finally, these carriers are shown to be non-cytotoxic and can be loaded with plasmid and proteins.