controllability. In fact, various biomimetic hydrogels have been employed to mimic the native hydrated microenvironment and to engineer thin or avascular tissues such as skins, cartilages and bladders. Thus the development of magnetic hydrogels holds great potential applications in tissue engineering and cell/drug delivery.

Various chemotherapeutic agents embedded in magnetic hydrogels can target pathological sites via magnetic drug targeting. For example, alginate hydrogels have been embedded with MNPs (iron oxide) to control drug and cell release both *in vitro* and *in vivo* by inducing large deformation and volume changes (over 70%) using an external MF (Zhao et al. 2011).

There are several methods to obtain magnetic nanoparticles entrapped inside hydrogels; MNPs can be directly introduced into the matrix of a preformed hydrogel or they can be added during the gel formation synthesis or alternatively they can be used as crosslinkers among the polymer chains (Fig. 11). For both *in situ* precipitation and the blending method, there are no covalent bonds between the MNPs and the hydrogel networks.

Saslawski et al. reported the preparation of alginate–strontium ferrite microspheres and Liu et al. (Saslawski et al. 1998; Liu et al. 2009) prepared some hydrogel beads with alginate gel cores and shells of magnetic nanoparticles. Liu et al. synthesized magnetic γ-Fe_2O_3 alginate microspheres (Liu et al. 2010) and Brule et al. prepared magnetic microbeads encapsulating a concentrated magnetic fluid composed of iron oxide NPs (diameter 8 nm) with a magnetic core into alginate (Brule et al. 2011).

All these methods share the lack of a specific interaction between the NPs and the polymer matrix allowing the movement of the NPs inside the hydrogels. Moreover the NPs can attract each other with the consequent formation of big aggregates, which

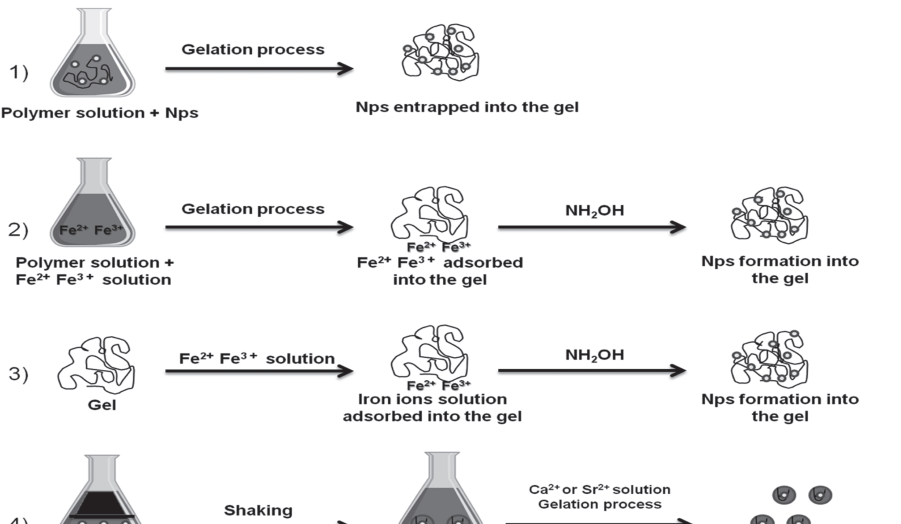

Fig. 11. Methods to obtain magnetic NPs entrapped inside hydrogels.