controlled release by heat induction. The gel coating on the other hand reduces particle oxidation, aggregation and increases their blood circulation time (Sundaresan et al. 2014; Sun et al. 2008). Likewise, encapsulation of small molecule contrast agents in gel nanoparticles reduces their toxicity and increases the measurement window and signal in MRI (Soni et al. 2015).

Functionalized and radio labeled acrylamide particles, fabricated by emulsion polymerization were proposed for imaging of lung tissue in PET-CT scans. The particles harbored a cell penetrating peptide and a bovine serum albumin-Alexa fluor dye complex for fluorescence analysis and radiolabeling of tyrosine. Size dependent retention time and inflammatory response were studied for imaging and drug administration in lung diseases (Liu et al. 2009).

Near infrared *in vivo* imaging also benefits from the properties of responsive gel particles. Indocyanin green is a near infrared (NIR) fluorescent probe, approved for clinical imaging but suffers from self-quenching, low circulation time and non-specific protein interaction. In gel nanoparticles the dye is incorporated in the auto-quenched state. If the gel is degraded by an acidic pH or by enzyme digestion, the dye is released and yields a fluorescent signal. These effects can be used in imaging of tumors by the acidic pH of tumor cells and metastasis, which is related to hyaluronidase activity (Soni et al. 2015).

Conclusions

Alongside the advances in regenerative medicine, a multitude of gel-based diagnostic devices and sensors have been proposed in recent years utilizing engineered hydrogel scaffolds. The enormous degree of freedom in designing microgel structures for convenient sample incubation has propelled these developments. Recent efforts in point-of-care diagnostic devices have focused on simple readout strategies to facilitate translation into clinical practice. Cross sensitivities of responsive gels towards pH, ionic strength and other compounds have to be considered and pose obstacles in the development of point-of care diagnostics. Similarly, a low specificity in cell-based toxicological assays has been challenging. Other obstacles to overcome include limited shelf life, and elaborate assay protocol steps. Whilst the first can be tackled by improved immobilization techniques and material science, the latter has led to a number of smart engineered devices for simple operation. For a broader acceptance of these novel sensing technologies the focus of future research has to expand from fundamental principles to validation with complex, clinical specimens.

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