was utilized for protein analysis in a 96-well plate format. Twelve open and free standing gel lanes were photo-polymerized on a substrate with 8 serial 2 x 2 mm wide sample reservoirs at a distance of 9 mm. Proteins were separated within a short timeframe, in the gel between two reservoirs, yielding highly parallel analysis (Duncombe and Herr 2013).

Selective patterning of gel membranes in microchannels for on-chip electrophoresis has been utilized for improved sample handling. Electrophoretic sample and antibody loading against a gel membrane was used in matrix metalloproteinase 8 analysis within saliva samples (Herr et al. 2007). Likewise, we patterned a hydrogel plug in a double-T injector to separate the sample from clean buffer in ion detection of water samples by capacitive contactless conductivity measurement (C4M). Blocking parasitic flows by the gel barrier, allows for a well-defined ion plug in a mobile setup for field applications. The sample and the separation channel were rinsed independently after each experiment, enabling a continuous operation mode (Puchberger-Enengl et al. 2013). Hydrogel barriers were also used in microfluidic chips to capture bacteria and viruses from a continuous flow for sample pre-concentration (Puchberger-Enengl et al. 2011) and subsequent lysis and RNA purification (Hubbe et al. 2013). An electric field perpendicular to the sample flow was applied to direct bacteria and viruses towards a gel membrane. Keeping them away from the electrodes prevents biofouling, lysis and irreversible attachment.

Gel membranes were also implemented in microfluidic chips for diffusion studies without physical contact. In diffusion-based chemical gradient generators the gel is separating cell cultures in a static environment from adjacent continuous flows of a chemical source and sink. Conversely, the gel can be polymerized with a drug concentration gradient and subsequently incubated with a cell culture. Gradient generators are useful tools in chemotaxis studies and high-throughput drug screening (Cheng et al. 2007; Kim et al. 2015; Ostrovidov et al. 2012).

On-chip diffusion membranes have been employed for molecule transport between separated cell cultures to study chemical cell signaling (Bryne et al. 2014). Recently, we developed a device for antibiotic testing of bacteria samples. The design comprises permeable hydrogel culture wells in a glass chip, enabling simple control of culture conditions and analysis. A thin gel barrier, loaded with antibiotics enables oxygen supply and facilitates on-chip analysis by chemical access through the gel while keeping the sample bacteria trapped inside the well. Nutrients and drugs are provided on-chip in the gel for a self-contained and user-friendly handling and rapid antibiotic testing (Puchberger-Enengl et al. 2015).

Gel particles in medical imaging

Responsive and functionalized micro- and nanogel particles have been introduced in medical imaging technologies. Responsive gel coated magnetic nanoparticles possess great potential in combining drug delivery with magnetic resonance imaging (MRI) systems. Magnetic particles add further functionalities to the gel drug delivery systems increasing the possibilities for magnetic targeting, contrast enhancement, and