ABSTRACT

The current energy debate considerably affects science, economy and politics. A key aspect of this discussion is energy saving by improvement of thermal insulations for buildings. In this regard, *nano insulation materials* are the insulation materials of the future. However, the realization of these high-potential materials is accompanied by many challenges, as for example the extremely high interfacial tension emerging during foaming that cause an undesired coarsening of the structure. To overcome these challenges, new strategies and templates have to be scientifically developed. Moreover, it is crucial to understand the foaming in detail. In this context the early state of foaming was studied by means of the *Principle Of Supercritical Microemulsion Expansion* (POSME). The benefit of using super- or near-critical CO_2-microemulsions is the thermodynamic stability at high pressures. This allows a fast repeatability of the expansion process at nanoscale by applying pressure cycles. In combination with a specially designed stroboscopic high pressure cell, the structural processes could be observed by time resolved small angle neutron scattering experiments. It turned out that the addition of a low molecular oil as *anti aging agent* results in a deceleration of foam coarsening by more than an order of magnitude. Parallel to these studies, the *Nanofoams by Continuity Inversion of Dispersions* (NF-CID) principle was utilized for the preparation of nanoporous polymers. The significant innovation of the NF-CID principle is the generation of an extremely high number density of propellant pools by a continuity inversion of a CO_2-soaked colloidal crystal, i.e. the formerly discrete polymer nanoparticles convert into a homogeneous matrix with nanodisperse fluid inclusions, if the glass transition temperature is exceeded. Expanding those templates by applying a specific set of parameters led to polymethylmethacrylate and polystyrene nanoporous materials that feature pore sizes smaller than 100 nm.