Abstract

In the age of the climate change water-containing fuels can contribute effectively to the reduction of exhaust emissions from internal combustion engines and therefore to the compliance of legal regulations. In particular, the breakthrough of the hardly controllable "soot–NO_x–trade–off" is of key importance. Through the use of water extensive and expensive exhaust gas after treatment technology can be renounced. Within the scope of this work fuel microemulsions containing diesel and GtL were characterised, optimised and simplified. These have been further developed into efficient and water-rich nanoemulsions containing low surfactant amounts that match engine and ecological requirements. Nanoemulsions offer the advantage of comparatively small structures such as microemulsion and thus very well distributed water, but require only small amounts of surfactants. These nanoemulsions were investigated with respect to their structure and stability by means of dynamic light scattering. Moreover, the formation and disintegration kinetics were analysed by means of stopped-flow measurements. Thus it could be ensured that the formation rate for formation in the engine itself is fast enough. Such fuel emulsions were generated dynamically with on-board water admixture in a BMW test vehicle. The emission behavior was investigated on the basis of the WLTP cycle relating to CO, CO_2, HC and NOx, fuel consumption and soot. Furthermore, the soot was characterised by its particle size distribution. During the investigations significant emission improvements could be detected. The application of water reduced the fuel consumption and an increased engine efficiency in some cases. The breakthrough of the "soot–NO_x–trade–off" could be confirmed for all investigated systems. Significant emission reductions of nitrogen oxides and soot up by to 66% could be achieved. Finally, it could be recognised with the help of the exhaust gas examinations that there is a specific water content for each engine operating point which achieves ideal results with respect to the emission reduction. Through the application of optimised nanoemulsions this can be selectively adjusted.