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Monitoring of Foam Formation by an Ultrasonic Reflection Technique

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We report on the application of an ultrasonic reflection technique using longitudinal and shear waves for monitoring the foaming process of polyurethane. A time resolution of 10 ms is obtained. The main advantage of the reflection method as compared to pulse-transmission technique is, that the reflection coefficient can be detected during the whole process of foaming. The reflection coefficient $r = A/A_0$ and the phase shift $\Delta\phi = \phi - \phi_0$ are estimated from the measured amplitudes A and phases ϕ of the loaded cell and the amplitudes A_0 and phases ϕ_0 of the unloaded cell for the first longitudinal and shear wave echoes. The acoustic reflection coefficient contains information integrated over the penetration depth of the ultrasonic waves. The time evolution of the shear and the longitudinal reflection coefficients is related to nucleation and growth of gas bubbles in the early stage of foam formation, vitrification of the polymercomponent, and formation of a cellular structure.