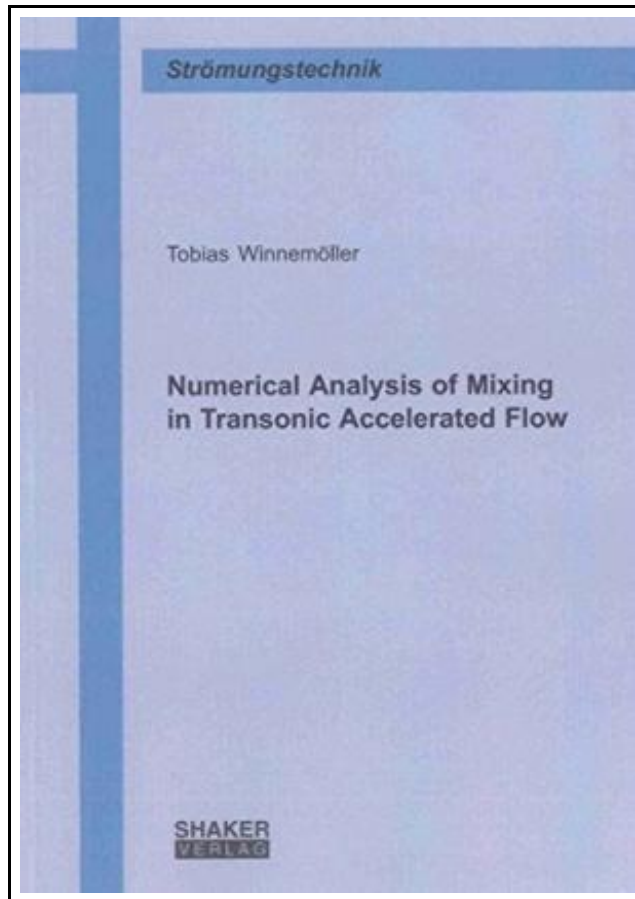


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NUMERICAL ANALYSIS OF MIXING IN TRANSONIC ACCELERATED FLOW



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Shaker Verlag Jul 2013, 2013. Buch. Book Condition: Neu. 208x146x12 mm. Neuware - To analyze the gasdynamical generation of nanoparticles, the turbulent mixing of the heavy gas tetraethoxysilane (TEOS - $\text{Si}(\text{C}_2\text{H}_5\text{O})_4$) in a hot accelerated air co-flow is numerically investigated for two injector configurations, one with a plane geometry and one with a streamwise-ramp geometry. The precursor gas TEOS is premixed with nitrogen and ejected through circular holes in the base of an injector into the nozzle flow at a co-flow Mach number of $\text{M}_{\text{co-flow}} \sim 0.66$ and a temperature of $T_{\text{co-flow}} \sim 1200\text{K}$. Immediately downstream of the blunt trailing edge of the injector the flow field is accelerated to supersonic speed. The mixing is dominated by pronounced free shear layers generating trailing vortices, which transport the partially mixed precursor gas but do not enhance further mixing. After a certain mixing length a shock train decelerates the flow to subsonic speed and rapidly increases the temperature, which, after the elapse of an ignition lag, starts the reaction of the precursor with oxygen that generates the nanoparticles. The mixing process is determined by a multi-species large-eddy simulation (LES) that covers the mixing process in the injector wake and across the shock wave. The analysis of the mixing process upstream of the shock shows advantages for the injector with a streamwiseramp geometry over the plane injector configuration. Especially the temporal homogeneity is improved as a result of reduced vortex shedding at the injector base. Nevertheless, the mixture is sub optimal, even for the injector with streamwise ramps. The mixing process suffers from a rapid turbulence decay in the wake of the respective injector due to the acceleration of the flow. The remaining fluctuations are not strong enough to sufficiently drive the mixing process. The overall mixing quality is approximately 25% higher for...



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