

Preparation and structure-sensitive investigations on silica glass fibers

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Fused silica fibers (Herasil I, HSQ 100 and Suprasil II) were prepared under defined and systematically varied drawing conditions by means of the rod pulling method. Within the scope of the investigations several particularities of processing and application of the rod pulling method are given with respect to the defined preparation of infinitely long silica glass fibers with diameters in the range of textile glass fibers (6 to 25 μm). The optimum range of the rod pulling parameters and also the connections to the drawing parameters of nozzle drawing method are given. Under these presuppositions the three silica glass fiber types were investigated by means of the optical birefringence and apparent (frozen-in) stress optical constant, respectively, by density changes as compared to the bulk glass and by the expansion and shrinkage behaviour on heating and annealing, respectively. The results of the apparent stress optical constant and of the apparent Poisson ratio calculated from density and shrinkage data of the silica glass fibers compared with the corresponding results obtained from former investigations on metasilicate-, metaphosphate- and E-glass fibers indicate the existence of asymmetric hollows of the open silica glass structure deformed and oriented by the fiber drawing process. The different concentrations of hydroxyl in the three selected silica glass types and the density anomaly reflect clearly the different mechanical and optical properties.