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An invited talk

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Several Key Factors Influencing Fracture and Tensile Strength of Glass fibers

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Understanding of the fracture mechanism and tensile strength of glass and glass fibers has been a challenging subject for glass scientists over the past century. In the present work, we report our recent findings about the fracture behavior and the tensile strength of the oxide glass fibers. We found several key factors that considerably influence the tensile strength of both continuous glass fibers and discontinuous wool fibers. Based on a large amount of the tensile strength data, it is revealed that the fiber drawing force enhances the tensile strength of the oxide glass fibers. This enhancement could be attributed to the two factors: the structural anisotropy and the macroscopic defect (flaws, bubbles, striae et al) orientation, both of which are induced by the fiber drawing forces. This finding is further verified by annealing experiments on both continuous and wool fibers below T_g. The onset annealing temperature of the tensile strength decay is close to that of the anisotropy relaxation of the continuous fibers. The relative contributions of the different factors to the tensile strength are distinguished and estimated in terms of the tensile strength decay as a function of the sub-T_g annealing temperature in order to better understand the fracture mechanism of glass fibers. Furthermore, we illustrate both special and general fracture patterns of glass fibers. Finally, we demonstrate and explain how the tensile strength of the discontinuous wool fibers is related to the redox state of iron.