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Publication date:
2010

Document Version
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Smedskjær, M. M., Deubener, J., Mørup, S., & Yue, Y. (2010). *Formation of SiO₂-Rich Surface Layer on Glass Fibers*. Poster presented at 2010 Glass and Optical Materials Division Annual Meeting, .

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Formation of SiO₂-Rich Surface Layer on Glass Fibers

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Man-made amorphous stone wool fibers are widely used for thermal and sound insulation and as a fire barrier. The applications of the glass fibers are influenced by their chemical and mechanical properties and high temperature stability (HTS). In this work, we study the surface modification of iron-bearing aluminosilicate glass fibers by using an internal diffusion process to change the chemical composition of the fiber surface. It is found that reduction of Fe³⁺ to Fe²⁺ results in diffusion of network-modifying cations from the surface toward the interior of the fibers. Consequently, a silica-rich surface layer is created. The extent of the inward diffusion increases with the degree of Fe³⁺ reduction, and the latter can be varied by changing the duration and temperature of the heat-treatment. We demonstrate the impact of the surface modification on the crystallization behavior, HTS, and chemical durability of the fibers.