

Fiber-Matrix Interphase in Short Glass Fiber Composites: Experimental Investigation and Micromechanical Modeling

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This contribution is focused on the analysis of the interphase in applied short glass fiber reinforced thermoplastics. The interphase in fiber-matrix composites is defined as the intersection region with modified bulk material properties [1]. Especially for FE simulations of composites and the validation of multi-scale material modeling approaches, the information about the existing interphase becomes important. In this study, the interphase thickness in a short glass fiber reinforced PBT is measured by nano-scratching. This common methodology [2] is improved and adapted to the use in short fiber composite specimens. As shown in Figure 1, scratches in different directions over the matrix-fiber transition are performed. Thereby, the measured range of interphase thickness represents the inhomogeneity of the interphase. In addition, a comparison of the interphase and the fiber sizing thickness shows a significant larger interphase.

Using the entirety of the determined information, the interphase volume fraction of the entire composite is calculated and inserted in a double coated material model, originally introduced by Hori and Nemat-Nasser [3]. The present study extends this model to the application on a double inclusion consisting of an elastic fiber surrounded by a viscoelastic interphase, embedded in a viscoelastic matrix. The developed model is compared to other existing approaches and finally validated in case of the present thermoplastic glass fiber composite.

In summary, this study provides an experimental distinction between fiber sizing and interphase thickness and contributes to the improved description of injection molded composites in applied material modeling.

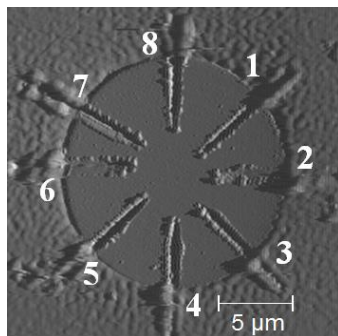


Figure 1: Performed nano-scratches to determine the interphase thickness in the cutting plane between the fiber and the matrix

[1] Moginger B, Lutz C, Polsak A, Muller U. Morphological-Studies of Deformed Polybutylene Terephthalate (Pbt). *Colloid Polym Sci.* 1991;269(6):535-542.

[2] Hodzic A, Kim JK, Stachurski ZH. The nano-scratch technique as a novel method for measurement of an interphase width. *J Mater Sci Lett.* 2000;19(18):1665-1667.

[3] Hori M, Nemat-Nasser S. Double-Inclusion Model and Overall Moduli of Multiphase Composites. *Mech Mater.* 1993;14(3):189-206.