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Hörsaal für Physik

"What bonds paper together?"

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Paper is one of the most versatile materials in human society. It is used for delivering and storing information as well as to protect food and other goods from the environment. Although paper is already known for about 4000 years, the process of bonding two fibers together is still an open discussion.

During the fabrication cycle of paper, single pulp fibers approach each other and form bonds during the drying process. The mechanism of forming bonds between two single fibers is up to now a speculative issue. There are several mechanisms suggested that play a significant role in forming fiber-fiber bonds that lead to a fiber network that is called paper. Lindström et al. proposed the following five bonding mechanisms [1]: (i) mechanical interlocking, (ii) hydrogen bonds, (iii) electrostatic interactions, (iv) interdiffusion, and (v) induced dipoles.

In this work, a method is introduced that is based on conventional atomic force microscopy (AFM) technique to measure the desired bonding force. Besides this single quantity, the behavior prior to the failure is analyzed and correlated to the true bonded area, recorded by conventional AFM scanning. This comprehensive investigation reveals new insights into the mechanisms of fiber-fiber bonding and their contribution to the fiber-fiber bond. Furthermore, time dependent behavior, such as creep and relaxation can be studied. Additionally, a comparison between dry and wet fibers is presented, revealing the influence of drying on the fiber surface morphology.

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[1] Lindström, T.; Wågberg, L. & Larsson, T., *Proc. 13th Fundamental Research Symp.* **2005**