

Supplemental Material to

Single-Molecule Measurement of the Strength of a Siloxane Bond

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Oxidation of silicon wafers

The substrate of the experiments in question was a lightly boron-doped silicon (100) wafer which was oxidized in a wet oxygen atmosphere at 1000 °C for 5 hours as described in the literature.^{1,2}

Synthesis of the siloxane polymer

The dimethylsiloxane polymer with different terminal functionalities was obtained as the main component of a product mixture. Firstly equilibration and condensation of a linear polydimethylsiloxane with on average 50 dimethylsiloxane units and terminal Si-H functional groups with a linear polydimethylsiloxane with also 50 dimethylsiloxane units on average and terminal silanol functionalities by means of phosphorus nitrile chloride³ as catalyst results in a reaction mixture containing mainly a dimethylsiloxane polymer with a Si-H functionality on the one end and a silanol functionality on the other end. Finally this precursor was treated with silicon tetrachloride. The terminal silanol functionalities reacted with SiCl₄ under evolution of hydrogen chlorid and formation of highly reactive trichlorosilane end groups. The average molecular constitution was H(CH₃)₂Si-O-((CH₃)₂Si-O)₄₈₀-SiCl₃ as shown by ²⁹Si-NMR-spectroscopy.

References:

1. Runyan, W. R.; Bean, K. E., Thermal Oxidation of Silicon. In *Semiconductor Integrated Circuit Processing Technology*, Addison-Wesley Publishing Company, Inc.: 1990.
2. Cleavelin, C. R.; Pas, S.; Vogel, E. M.; Wortman, J. J., Oxidation. In *Handbook of Semiconductor Manufacturing Technology*, Nichi, Y. a. D., R., Ed. Marcel Dekker, Inc.: New York, 2000; pp 167-169.
3. Hager, R.; Schneider, O.; Schuster, J. Patent US 5,380,902. 1995.

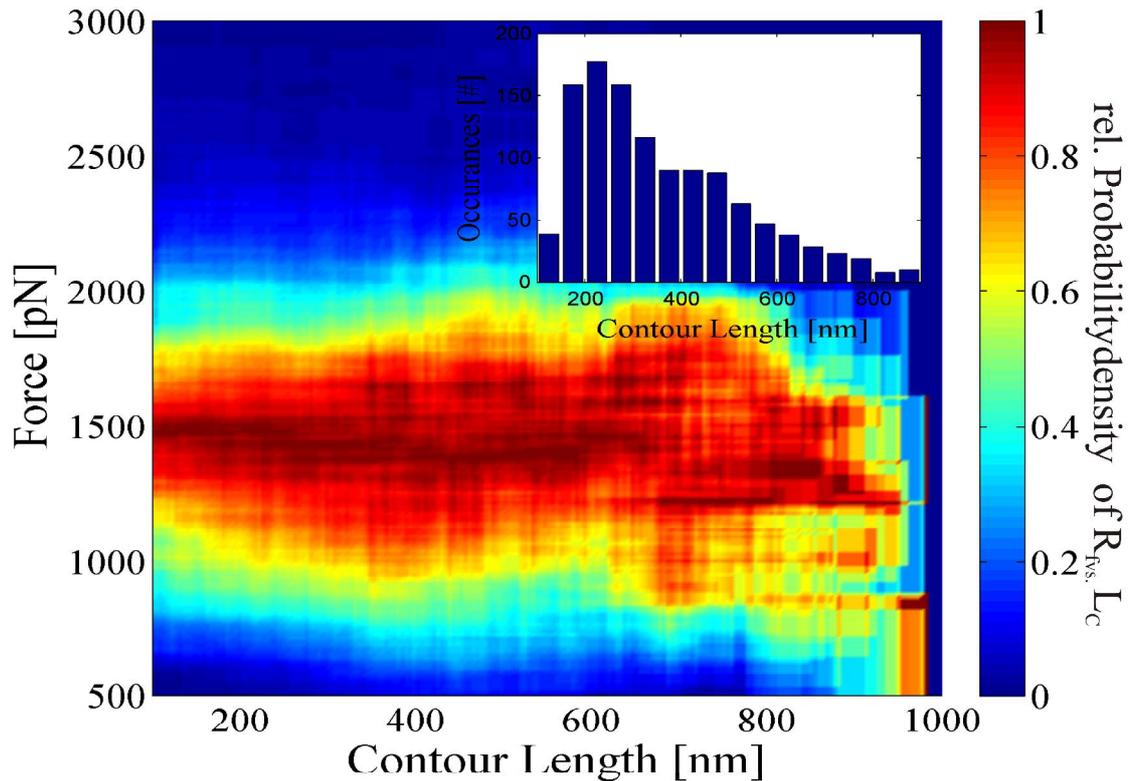


Figure S1: Dependence of rupture force on polymer length. The graph shows in false colors the normalised probability density for observing a certain rupture force at a molecule of a certain length. The inset shows the histogram of number of occurrences per length interval. We find that in our measurements of PDMS the rupture force dose not depend on the polymer length. Only very short ($l < 150\text{nm}$) or long ($l > 800\text{nm}$) contour lengths seem to influence the distribution of rupture forces. However, for these extreme cases less than 40 individual events were measured, giving the edges of the probability density a low statistical confidence. We therefore in our dynamic force spectroscopy analysis use the mean polymer length in order to compute a loading rate for all observed rupture events.