**Dynamic Mechanical Analysis (DMA) Data Processing and Evaluation.** Both the rupture experiment data and the dynamical stretch data were provided as raw data in csv-format, containing strain data as the independent variable and noisy stress data as the dependent variable. Measured force (stress) values were extremely low, resulting in a low signal-to-noise ratio and requiring a denoising process to allow for data visualization and analysis. Data derived from rupture experiments were denoised using a Savitzky-Golay Filter of window size and order . This specific filter type was chosen due to its extrema-preserving nature [doi:10.1021/ac60214a047] – a desirable characteristic for exact identification of the rupture point. The corresponding exact maximum strain value was then extracted by identifying the maximum index of the denoised stress data and allocating the corresponding strain value.

The sinusoidal dynamic stretch experiment data were denoised by perfoming a fast fourier transform cancelling out all spectral parts associated with sensor and background noise. This was achieved by visually inspecting the spectral plots, sorting for descending power density, fixing a small interval of neighboring frequencies around the frequency of highest power magnitude, zeroing all other frequencies and transforming back into time domain. Rising and falling signal edges were evaluated separately. They were identified and classified by overlaying the stress-strain data points for 50 periods, performing a linear least squares regression. The resulting regression line was used to assign every measured value to the rising and the falling edge, respectively. The classified data pairs were plotted to obtain stress-strain curves for each sample. Subsequently, the confidence bands for the stress-strain curves were calculated by grouping stress values by edge type (rising or falling) and strain value, averaging the stress values per strain value and calculating the pooled variance , k being the number of groups, using the mean and deviation of the mean per strain value. Finally, Young’s modulus was calculated based on the slope of the secant connecting the zero point and the maximum points in the stress-strain curve.