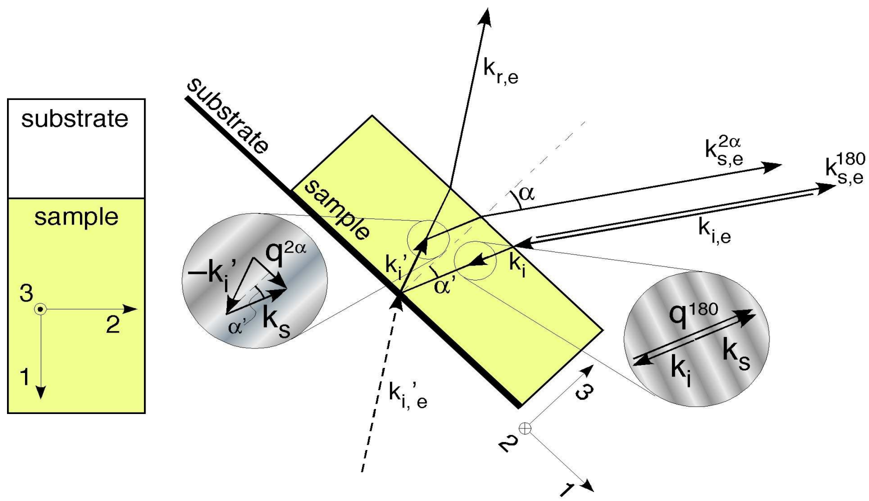
Supporting Information



Scheme S1. Backscattering setup for Brillouin scattering. k_i, k_s, and k_r are the incident, scattered, and reflected beams; 1 and 2 directions are in the growth plane of the sample, and direction 3 is normal to the growth plane; α is the angle k_i makes with the 3 direction; q is the phonon propagation direction.

Scheme S1 shows this frequency shift measured at different locations on the film, here the inner and outer peaks are the 2α and 180° peaks, respectively. This frequency shift, *Δf*, in scattered light is proportional to the phonon velocity, *υ*, using Equations 1 and 2

$$\upsilon_{180} = \frac{\lambda \Delta f_{180}}{2n}, \qquad (1)$$

$$\upsilon_{2\alpha} = \frac{\lambda \Delta f_{2\alpha}}{2\sin\alpha}, \qquad (2)$$

where *λ* is the wavelength of the incident beam, *n* is the refractive index and *α* is the angle between the incident beam and surface normal (45º). By combining Equations 1 – 2, along with the sample density, the longitudinal elastic modulus of the Kevlar film can be determined according to

$$c_{11} = \rho \upsilon^2 \qquad (3)$$

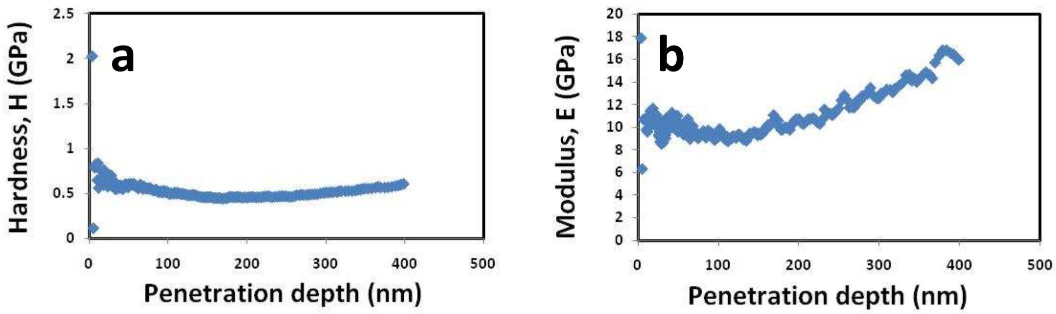


Figure S1. Typical results from nanoindentation experiments for PDDA/ANF_{300} LBL film with maximum depth set at 400 nm showing clear depth-sensing characteristic with depth bigger than 200 nm. a) Represents the hardness as a function of penetration depth and d) corresponding modulus. These results are from the loading part of the experiment.

Wave number (cm^{-1})	Assignment
1181	C-C ring stretching
1277	C-C ring stretching
1327	C-H in plane bending
1514	C-C ring stretching
1569	N-H bending, C-N stretching
1610	C-C ring stretching
1648	C=O stretching, C-N stretching, N-H bending

Table S1. The assignment of Kevlar active modes.