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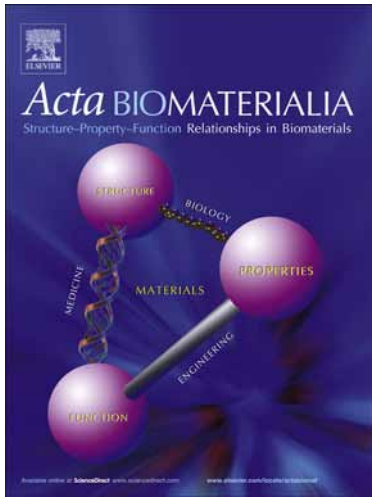

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Micromechanical properties of strain-sensitive lyriform organs of a wandering spider *(Cupiennius salei)*.

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Abstract

Highly sensitive lyriform organs located on the legs of the wandering spider *Cupiennius salei* allow the spider to detect nanometer-scale strains in the exoskeleton resulting from locomotion or substrate vibrations. Morphological features of the lyriform organs result in their specialization and selective sensitivity to specific mechanical stimuli, which make them interesting for bioinspired strain sensors. Here we utilize atomic force microscopy (AFM)-based force spectroscopy to probe nano-scale mechanical properties of the covering membrane of two lyriform organs found on *Cupiennius salei*: the vibration sensitive metatarsal lyriform organ (HS10) and the proprioreceptive tibial lyriform organ (HS8). Force distance curves (FDCs) obtained from AFM measurements displayed characteristic multi-layer structure behavior, with calculated elastic moduli ranging from 150 MPa to 500 MPa for different regions and indentation depths. In addition, we probed the lyriform organs with a large radius tip, which allowed for probing structural deformation by the application of high forces and large scale deformations without damaging the surface. The viscoelastic behavior of the sensor materials observed in this probing suggests mechanical relaxation times potentially playing a role in the time-dependent behavior of the lyriform organs.

Keywords: Mechanosensing, Epicuticle mechanics, Relaxation time, Force spectroscopy, Biosensing, *Cupiennius salei*

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