Decoding Deformations

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Size matters, especially when probing the mechanics of materials. Our research uses flat-tipped needles to gradually apply force and deform a sample until its surface fractures and the needle penetrates through. By analyzing the force-displacement data from these tests, we extract key mechanical properties, such as the elastic modulus and strain energy release rate. However, when samples are confined to very small spaces—like a 96 well-plate—the relative scaling between the sample and probe dimensions (R_{well}, h_{well}, $h_{meniscus}$, and R_{probe}) alters deformation behavior. In our study, we decode how this scaling effect causes deviation from existing puncture models and account for it in an experimental correction factor, **k'**. This adjusted mathematical framework enables researchers to characterize materials at smaller volumes and higher throughput; facilitating the development of advanced materials, either manually or through machine learning-driven optimization.



