Nonlocal Deformation Sensing Using Nanodiamond Quantum Sensors - Towards Live Cell Applications

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The long spin coherence time of NV centre electrons in diamond make it particularly attractive for bio-sensing applications. In the present work, we show that the integration of AFM-indentation and vector magnetometry of NV centres in nanodiamond leads to a new scheme of high precision non-local deformation sensing, the mechanical analysis of which no longer relies on the knowledge of local interaction between the AFM tip and the indentation location. The feasibility of the method is firstly demonstrated using polydimethylsiloxane film and gelatin microparticle. The excellent sensitivity and spatial resolution associated with such a technique enable the disclosure of heterostructured nature of the former, and effect of surface tension in the latter. We then expand the protocol into a generic method for unambiguous characterization of intrinsic mechanical properties of materials, especially for bio-relevant soft materials. The demonstration on a fixed cell in liquid clearly discloses the interplay of capillarity and elasticity, which would have been overlooked by the conventional methods. We will also discuss the most recent progress in developing the methods towards live cell measurement, that is, a strategy that can differentiate the induced mechanical response from other noises including live-relevant activities. The works are carried out in collaboration with Renbao Liu, Yue Cui, Wenghang Leong, Guoli Zhu, Kangwei Xia and Chufeng Liu.

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