Studies of Non-Linear Deformation by Electric Point Contact

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An electric point contact is used to identify the physical deformation of an object initiated by a nondestructive impact. The detection of electric signal allows a spatial sensitivity that is two order-of-magnitudes higher than those through video or audio detection, with a temporal response that is an order-of-magnitude faster than those from piezoelectric response. The electric contact on insulating object is made possible by the deposition of a very thin layer of graphite powder from a 2B pencil on the surface. Surprisingly, 37 consecutive rebounds in 2.06 sec of a free-fall ping-pong ball from an initial height of as low as 4 cm, with a final rebound reducing to as short as 10.3 μm, can be clearly resolved. An ultra-small deformation for 7.36 μm can also be detected more efficiently. The non-linear behavior of the bouncing probe, resulted from the surface adhesive and body softness of a soft object, was used to study the viscoelasticity and surface adhesion of soft materials. A piece of thin silicone wafer was utilized in order to distinguish the external surface adhesive and internal body viscoelastic of dough without affecting to the premise of natural properties. A critical exponent that indicates the fermentation of dough was extracted from the non-linear bouncing motion. The non-linear damping oscillation of dough was also able to observe through a reflection amplification, and found that the damping constant of dough is indeed not a constant.

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